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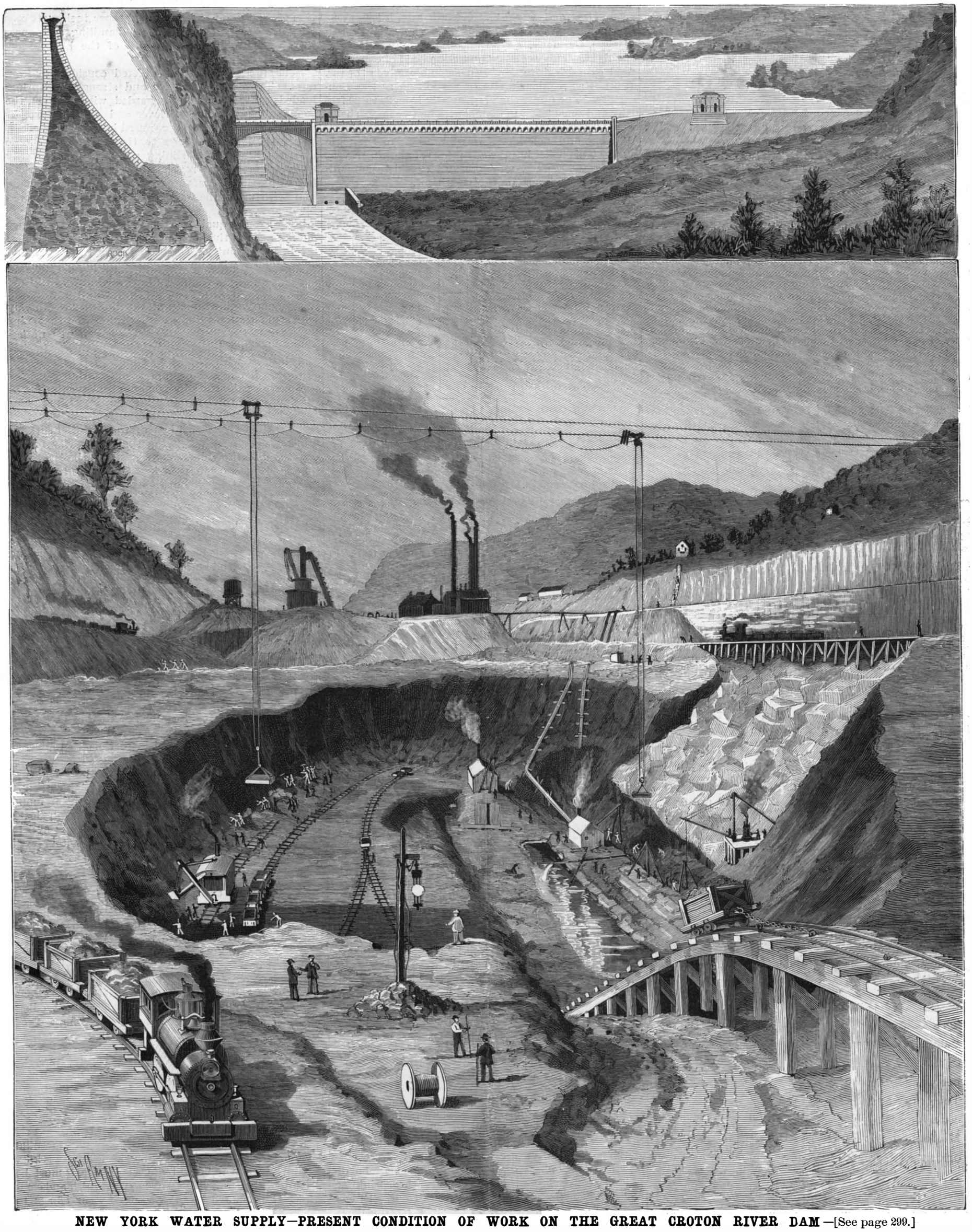

NEW YORK WATER SUPPLY—PRESENT CONDITION OF WORK ON THE GREAT CROTON RIVER DAM —[See page 299.]

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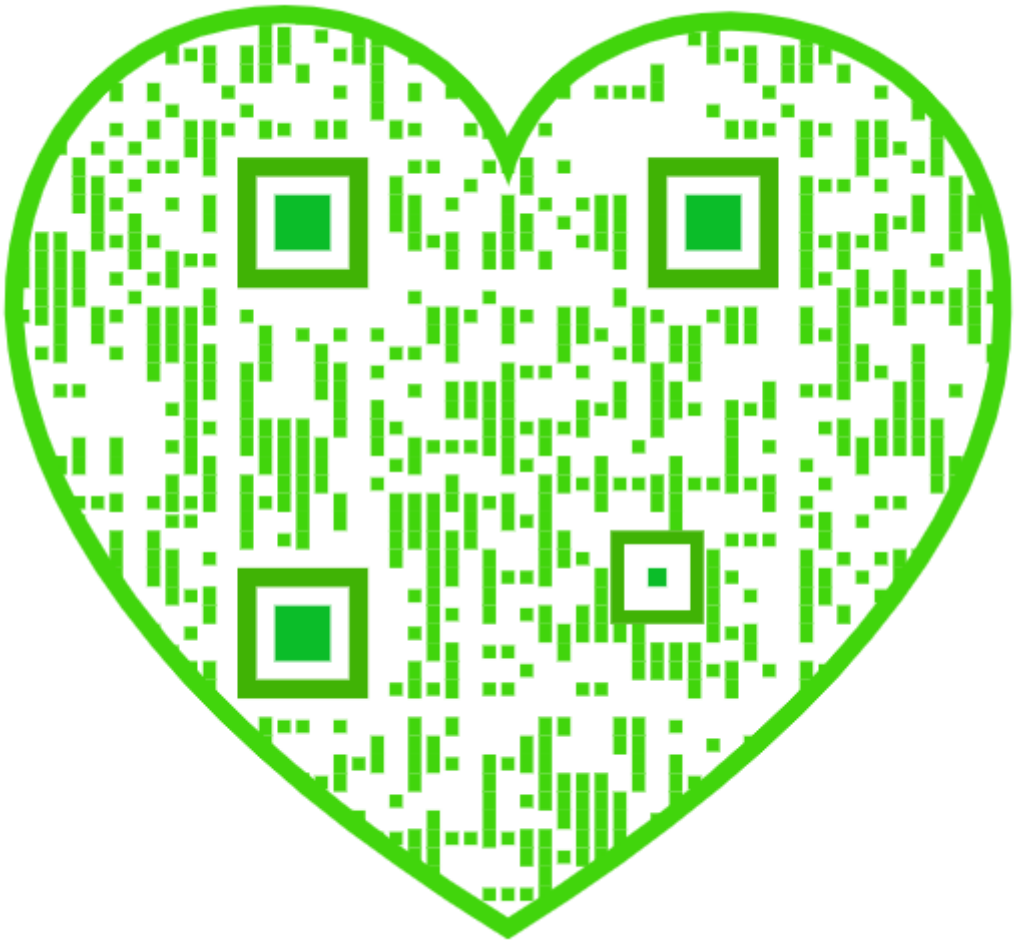

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EUROPEAN PRACTICE IN STEAM BOILERS.

The report of Mr. R. S. Hale, expert to the Steam Users' Association, on steam boiler practice in Europe is a valuable document, being a record of the personal observations of a practical man upon a subject which should command a widespread attention.

The standard type of boiler, with one or two exceptions, is "the internally fired flue boiler," of which there are two types—the Lancashire boiler, with two flues, and the Cornish, with one. It is generally about 7½ feet in diameter and 30 feet long, with a grate 6 feet in length, and provides 36 square feet of grate and 1,000 square feet of heating surface. As built in England to carry say 160 pounds pressure, it costs $2,500, and will deliver 6,000 pounds of steam per hour, Used with an economizer and worked at a lower rate, it is "as economical as any type of boiler." In France and Elsass (Alsace), Germany, a type known as the "elephant" is standard. This is classed under the head of externally fired cylindrical in Mr. Hiller's table given below. It is not as regular in size or proportion as the Lancashire. The upper shell is generally from 20 to 30 feet long and some 5 feet in diameter. The two lower shells, called "bouilleurs," are about 2 feet in diameter. They have one and sometimes two connections to the main shell. This boiler has the advantage of allowing a very large grate surface, an important consideration with the poor coals in use on the Continent.

PER CENT OF BOILERS OF VARIOUS TYPES USED IN EUROPE.

	United Kingdom. 1896.	France. 1893-4.	Germany. 1893-4.	Switzerland. 1893-4.	Austria. 1893-4.
Lancashire and similar types.....	38·0	4·7	35·7	19·6	*
Cornish and similar types.....	23·7	8·2	15·3	40·8	*
Externally fired cylindrical †.....	6·8	57·3	14·8	15·5	41·0
Externally fired multitubular.....	.....	13·4	5·2	3·5	7·5
Locomotive.....	11·0	5·1	17·3	5·7	10·5
Small verticals.....	16·6	3·6	5·0	13·5	6·1
Water tubes.....	1·8	5·7	4·6	1·4	3·8
Other types.....	2·1	2·0	2·1	.....	1·4
Totals.....	100·0	100·0	100·0	100·0	100·0

* Lancashire, Cornish and similar types, 29·7. † Including elephant.

In boiler construction Mr. Hale "judges the English workmanship to be fully equal to our best." The plates are planed on the edges, drilled in place and no punching is allowed, and steel is almost exclusively used. The longitudinal seam of the flues is generally welded, and corrugated flues are frequently used, though "most frequently the improvement did not" appear to "warrant the expense." As compared to 140 to 150 pounds pressure for a new mill in America, 200 pounds would be the practice in England, 180 in Alsace and 140 to 150 in Belgium and Germany.

Economizers are more common in Europe than here, the type known as the "Green" being standard. "The most general practice was to put one economizer for each battery of boilers, making the economizer heating surface and the boiler heating surface the same. In Belgium, however, they were recommending one small economizer to each boiler. Scrapers are used to keep the fire surfaces clear of soot. The water surfaces are subject to scaling if the water be bad, and it is chiefly in the bad water districts that economizers are not used, though they are not much, if any, worse in this respect than water tube boilers. But when the economizers are taken out, the heating surface of the boilers must be more than doubled to get the same economy." An advantage claimed for the Lancashire boiler and for the economizers was that the large amount of hot water in them afforded a reserve of heat for a sudden call. An interesting application of this principle was the feed storage and steam storage system of D. Halpin, of London. It consists in providing tanks in which the feed is heated to the steam temperature by steam from the boiler during light demand, so that during the heavy demand the feed water is supplied hot (360° F. instead of 100° or 200°). The steam storage consists in having very high pressure boilers, which pressure is reduced at the engine. The system, however, did not impress the writer favorably, for the reason that coal can probably be saved equally well by using high pressure steam directly at the engine.

The use of superheated steam is very much in the air all over Europe. There has never been any doubt that it saved from 10 to 20 per cent of the coal; but there has been difficulty in lubricating the engine cylinder and in keeping the many superheater joints tight. The difficulty in lubrication is met by using a high grade mineral oil.

The grates in ordinary use resembled those in America. In Germany some of the under-fired boilers were provided with grates that inclined downward to the rear as much as a foot or a foot and a half, which was thought to be easier for the firemen and to give better combustion.

Mechanical stokers are used in probably over one-fourth of the boilers in England. They may be divided into two classes: the coking and the sprinkling stokers. The first feed the coal at the front, where it cokes, and is then carried to the rear by the reciprocating motion of the grate bars. The sprinkling stokers throw the coal over the grates by means of revolving or oscillating shovels. The Vicars is the best known coking stoker and the Bennis is the most widely used sprinkling stoker. Opinion as to the value of mechanical stokers is divided, but the drift of opinion was as follows: "No stoker absolutely prevented smoke, but both types very largely diminished it. In this respect the coking stoker had a decided advantage over the sprinkling. Neither stoker kept up the steam pressure on a sudden call as well as hand firing; in this respect the sprinkling stoker was considered to act more quickly than the coking." Opinion as to whether they saved coal was divided, the chief reasons for their adoption being the diminution of smoke and the use of a cheaper fuel. "It was thought that stokers and coal handling appliances together saved about one-third of the boiler room labor in large plants."

Boiler fittings in Europe differed considerably from ours. They were "heavier and stronger." Spring-loaded safety valves are regarded with distrust, the common types being the lever and the dead-weight valves. Two gage glasses are used instead of try-cocks, the use of which has been "entirely given up." The dampers are of the sliding and not the butterfly type, and are always regulated by hand. The various forms of artificial draft are "no more and no less in use than with us." The water gages are usually covered by guards.

"The average quality of the boiler and pipe coverings did not seem to the writer as good as those in general use in this country. Occasionally he saw wood and even rope covering on high pressure piping, some of which was already distinctly charred. Some plants, of course, had very good coverings, and there was a custom of covering the top of the boilers very thickly with some cheap covering, with the result that nine times out of ten the space over the boilers was noticeably cooler than it is in America." The variety in sizes and theories with regard to chimneys is as great in Europe as here. In boiler operation Mr. Hale observed that occasionally the admission of air above the fire at the door or at the bridges was practiced with the idea of diminishing smoke. The drift of opinion was that this resulted in a slight loss of fuel. Boiler surfaces are kept cleaner. When the specific gravity of the water is 1·005 they blow out and clean the boiler. Soda, lime, and potash are used in England, and they are beginning to "know about the advantages of kerosene on the Continent." Purifying plants "are not infrequent."

"Boiler testing is in some respects more advanced than with us, chiefly in that they attempt to tell where all the heat supplied goes to, and thus to determine the reasons of good and bad performance." The bomb calorimeter is used for determining the heat value of a coal. The Thompson and other calorimeters of that type are not considered in the least available for practical work. Coal tests are compared on the evaporation per pound of coal, boiler tests were generally compared on the evaporation per pound of coal "pure and dry," dry referring, of course, to the moisture correction, pure to a correction of the earthy matter contained in the coal, but not allowing any correction for the unburned coal in the ashes.

"In boiler economy I could not see that they were ahead or behind us; they get 60 per cent to 80 per cent of the heat in the coal, according to the air supply and evaporation per square foot of heating surface." The European engineers were fully alive to the "immense importance of the air supply, as compared with any other factor in boiler economy." It has been found that economy is modified by the air which leaks through the settings of some types of boilers; and in some places they were using heavy tar paint or even sheet iron casings to make the settings air tight.

Tall Buildings in Antiquity.

That even tall buildings are not modern ideas is shown by Professor Lonciani, in the North American Review. In Rome much the same tendency was shown to erect tall buildings as has been experienced of late years in America. They had not steel construction to aid them or elevators to land their tenants on upper floors, yet the desire to build lofty buildings was strong upon them, and successive emperors issued edicts limiting the height of houses, seventy feet being allowed by Augustus on the street front, but these regulations were repeatedly violated. With our facilities for iron or steel construction and the knowledge of elevators, the Romans would doubtless have matched us in "sky-scrapers." As it was, these ancient houses were often a hundred feet high. The Romans were great builders, and their speculators in this line would, without doubt, match ours in utilizing every inch of space without regard to light and air. Tenement house reform would have had in those early days a wide field to work in. Whatever else may be said of their Cæsars, it must be recognized that they had an eye to the health and comfort of the common people and used their efforts to check such buildings.

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Sylvanus Dyer Locke.

This noted and highly successful inventor of harvester and binder machinery, whose inventive genius also had a notable development in many other directions, died at his home, near Hoosick Falls, N. Y., on September 27, aged 63 years. His latest work was on a machine, of which he is said to have made a successful trial just before his death, for automatically making a detachable and continuous steel sprocket chain from a strip of steel. It was at Hoosick Falls, in 1870, that Mr. Locke succeeded in so far perfecting his automatic harvester and binder that it was conceded to be a practical success, and it became soon afterward a leading product of the Walter A. Wood Mowing and Reaping Machine Company. The machine cut and bound rapidly and well a swath eight feet wide, and the demand for it increased so rapidly that in 1878 more than 5,000 machines were manufactured and sold. Mr. Locke secured in all 104 patents in the harvester and binder field, besides numerous other patents relating to jointless vertical plane car couplers, electric vote annunciators for deliberative bodies, steel cross ties for railroads, underground wires and pipe conduits, snow melting for streets of cities, line guide copy holders for typewriting machines, hop picking machines, malleable iron detachable iron link chains, paper testing machines, etc.

Mr. Locke was a public spirited citizen whose personal worth was highly appreciated by everyone in the community of which he was so conspicuous a member for more than twenty-five years, and he took an active interest in all religious and charitable work. Many of his patents were obtained through the SCIENTIFIC AMERICAN patent agency, and during the several years in which we were so frequently brought into personal contact with him his strong convictions and rigid principles were always as marked a characteristic as was the self-reliant and energetic nature which contributed so powerfully to his success in life. He is survived by a wife and three children.

The American Institute Fair.

The popularity of this interesting exhibition has been greatly enhanced by the opening of the display of flowers, fruits and vegetables which is made in the concert room of the Madison Square Garden. The exhibit of palms is magnificent and there is a wonderful variety of dahlias, gladiolas and asters. Some five hundred varieties of grapes are arranged on the tables. Among the leading exhibitors in this department are Peter Henderson & Company, J. M. Thorburn & Company, and Weeber & Don, of New York City.

Among the interesting exhibits on the main floor is that of Francis Bannerman, of New York, manufacturer of the Spencer repeating gun. The display includes a 12 inch nickel steel solid projectile whose point only has been slightly damaged by firing, in a government test on the navy proving grounds, at nickel steel armor plates. Other shells and shot, similarly tested, are also shown, together with a great variety of curious and interesting relics and samples connected with military equipments of the past and present, at home and abroad.

The Rex Fire Extinguisher Company, of New York, manufacturers of chemical engines, exhibit a fine specimen of their hand machine, which can be readily drawn by one or two men to any section of a town or village not reached by water systems. It will throw over an ordinary house a stream of carbonic acid gas and water, claimed to be forty times more powerful as a fire extinguisher than water. In many places where there are steam fire engines these chemical engines are being added to the fire department to supplement the services of the more powerful steam fire engines.

The Photogravure Wood Company, of New York, show some excellent samples of carved mouldings and decorative solid wood and veneers, their artistic fire etchings, or pokerwork, being quite unique.

On the machinery floor, in the basement, the Law Company exhibit specimens of the work of the Standard Machine Company, of Holyoke, Mass., manufacturers of grinding and polishing machinery for all purposes.

Near by is shown the "Peerless Universal Sander" of E. J. Bein, of Newark, N. J., which presents a large flat surface to the work, the latter being guided by a gage. The belt is made of merchantable sand cloth of any desired number, the changing of the belt being the work of only a few seconds, while the tension is readily regulated

The heavy head shaft hanger, adjustable in all directions, and with changeable sole plate for varying drops, shown by the Dodge Manufacturing Company, of Mishawaka, Ind., is a standard article which has had very extensive use, as is also the case with their adjustable pillow block and short drop head shaft hanger.

Among other exhibitors on this floor are the Watson-Stillman Company, of New York, manufacturers of hydraulic machinery, tools and supplies, and the Excelsior Machine Works, Charles Hvass proprietor, manufacturer of street sweeping machinery and implements.

Expert Testimony.

Within comparatively recent years there has arisen in our judicial system an apparent need for evidence bearing upon scientific questions requiring a knowledge not ordinarily possessed by the lay witness, and which is gradually being more and more supplied by the so-called "expert." He is paid to testify on behalf of one side or the other and not infrequently is retained to appear as often as cases arise in which his opinions are desired. That the most flagrant abuses in expert testimony have made themselves most prominent in criminal cases is perhaps to be attributed merely to the notoriety which these cases have attained. Whether it be the fault of our patent system or of our judicial system, the expert has become a prominent factor in all recent cases pertaining to patent litigation. It is not uncommon to find several experts on one side arrayed against perhaps as many more on the other, and if each side has been able to retain men of practically equal prominence, that side having the greater number frequently produces no little effect on influencing the judicial decision. That men devoted to the interest of science should be willing to sell their opinions indiscriminately to either contending party, often being obliged to so modify their views as to make them harmonize with the unscientific but legal opinions of the counsel by whom they are employed, has become an evil which has justly brought forth criticism, must be acknowledged, and unless modified or changed in some form, calls for future condemnation also.

In a contribution to the October number of the Atlantic Monthly, Prof. John Trowbridge calls attention to the imperiled dignity of science and the law if the practice of indiscriminate scientific testifying is to continue. He points out the difficulty in which a judge is placed when required to carefully weigh statements on scientific points; his attitude toward the scientific expert and the little regard he frequently holds for his opinions. He is therefore tempted to entirely ignore expert testimony and rely upon his own common sense for framing his decision. The consequence has been that judges may be classified under several headings, a classification based simply upon their legal decisions in the past, some being known as patent breakers and others the most strenuous advocates of broad patent claims. It is for this reason that suits are carried from court to court with the ultimate hope that a former decision will be reversed.

The result of this method has been well illustrated and can be vouched for by several of the larger manufacturing companies who have invested millions in this way during the past few years, with no immediate prospects of any material return on the investment. The chief benefit has been derived by patent lawyers and patent experts, while the stockholder has been forced to respond with the shekels. Prof. Trowbridge does not, however, raise his criticisms without suggesting a remedy. It is to the effect that a judge may call to his assistance any well known professor of science not retained by the parties in dispute. The state should provide and the judge should appeal to the state for such assistance so that he might be aided in rendering a decision based upon scientific facts.

By this method both the standing of the bench and that of the professor would "gain in dignity and the pursuit of truth will again be considered one of the chief characteristics of a scientific life." Whether the method suggested by Prof. Trowbridge could be put in practice and would be effective even if adopted can only be determined by an actual trial. It is, however, well to call attention to these points, so that those who are tempted merely from a pecuniary standpoint to offer evidence on scientific questions, when such evidence would not be in entire accord with their best belief, may stop to consider the effective gain to be derived by so modifying their convictions as to make them harmonize with those of the contending counsel. It is not improbable that the day of the expert will soon be waning and that the costly litigations of the past will not be duplicated in the future.—The Electrical World.

A Fraud Upon Inventors.

Samuel S. Fisher, when Commissioner of Patents, in one of his annual reports to Congress, called attention to the great abuse to inventors and annoyance to the Patent Office by irresponsible patent agents, of which there were many at that time, and they have increased fourfold since. We quote from the Electrical Age, which says: "To arouse false hopes and cause an individual to invest in a worthless patent is fraudulent. It is a gold brick scheme, a phase of buncoism that has existed for years. Commissioner Fisher was right in warning the inventor. His language is direct and to the point: 'The tendency of many agents to be more solicitous about the number than the quality of patents is aggravated by those who solicit patents on contingent fees, or who without special training and qualification adopt this business as incident to a claim agency, and press for patents as they do for back pay and pensions. Such men are often more desirous of obtaining a patent of any kind, and by any means, than they are of obtaining one which will be of any value to their clients. Inventors are often poor, uneducated, and lacking in legal knowledge. They desire a cheap solicitor and do not know how to choose a good one. They are pleased with the parchment and the seal and are not themselves able to judge of the scope and value of the grant. Honest and skillful solicitors, with a thorough knowledge of the practice of the office and of patent law, and who are able and willing to advise their clients as to the exact value of the patents which they can obtain for them, may be of much service to inventors. There are many such. But those who care for nothing but to give them something called a patent, that they may secure their fee, have in many instances proved a curse. To get rid of their client and of trouble they have sometimes been content to take less than he was entitled to, and in many cases they have, with much self-laudation, presented him with the shadow when the substance was beyond his reach. Between such men and the office strife is constant.'"

Lucium, a New Element.

In the course of researches on monazite sand M. P. Barrière appears to have come upon a new elementary body, to which he has given the name lucium, and which he purposes using for the production of an incandescent gas light in opposition to that of Auer von Welsbach.

Hence he has sought to show the new and independent character of lucium in order to prove that its use was not anticipated by the Welsbach patents. A careful examination led to the following results.

The chemical properties of lucium are as follows: The salts of cerium, lanthanum, and didymium form with sodium sulphate insoluble double salts; lucium does not. Thorium and zirconium form insoluble double salts with potassium sulphate; this is not the case with lucium. Yttrium, ytterbium, and erbium are not precipitable by sodium thiosulphate, while lucium chloride is precipitable. From glucinium lucium differs, as its salts are precipitable by oxalic acid.

According to the results obtained by Prof. Schutzenberger, confirmed by those of Cleve, Fresenius, and Lecoq de Boisbaudran, lucium dissolves in sulphuric, nitric, or acetic acid, forming salts either white or slightly tinted with rose color. All its salts are soluble in water, forming limpid, colorless solutions.

The spectral rays of lucium are special, and only approximate slightly to those of erbium. Erbium oxide, on ignition, appears of a very pure rose color, and its nitrate is red. On the contrary, lucium oxide is white, slightly grayish, and its nitrate is white. The aqueous solutions of the erbium salts are red or rose color; those of lucium, even if containing 15 or 20 per cent of the salt, are almost colorless.

The atomic weight of lucium is calculated as = 104, while—

Thorium	= 233
Yttrium	= 89
Ytterbium	= 173
Scandium	= 44·5
Cerium	= 140
Lanthanum	= 156
Erbium	= 166
Zirconium	= 90
Samarium	= 150
Glucinium	= 9

Hence the authorities cited regard lucium as a new, distinct elementary body.—Chemical News.

Interesting Facts Regarding Divers.

The dress of a fully equipped diver weighs 169½ lb., and costs about $500. First of all comes 8½ lb. of thick underclothing, then follows the dress itself, weighing 14 lb.; boots, 32 lb., monstrous things with leaden soles; breast and back weights, 80 lb.; and, lastly, the helmet, which weighs 35 lb. When the hull of the Great Eastern was cleaned by divers as she was being loaded with the cable for the Indian submarine telegraph the contract price for the work was £1,800, and it was completed in six weeks by twelve divers. The incrustation on her bottom was more than a foot thick, and after it was removed she lifted fully two inches. The greatest depth at which a diver may safely work is 150 feet. There have been, however, rare instances of diving to 204 feet, and sustaining a pressure of 88½ lb. on every square inch on the body of the diver. Diving was first incepted by the action of the elephant in crossing a deep river, when he swims beneath the water, elevating his trunk, by which method he breathes. The work of a diver consists in recovering lost articles, and slinging them in such a manner that they can be easily hauled up, cleaning and coppering ships' bottoms, cleaning propellers, and communicating by slate and voice. When able to work at a depth of 120 feet a diver is considered fully qualified. The flag ships in the British navy carry eight divers, and the cruisers four each, fully equipped.—From the Strand Magazine.

THE Board of Education of Bayonne, N. J., have, through Mr. Charles M. Davis, city superintendent, ordered the introduction into the public schools of MacCord's system of mechanical drawing published at the office of the SCIENTIFIC AMERICAN.

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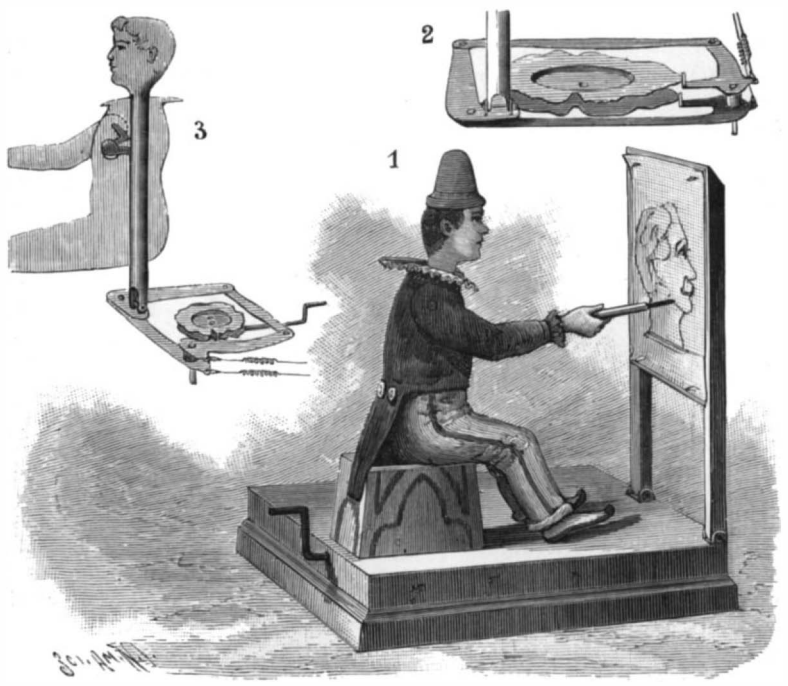
THE TOY ARTIST.

The mechanical toy shown in the accompanying illustration is one of the most original and ingenious things of its kind that have recently appeared. Within the base upon which the "artist" and his easel are placed, and immediately below the figure, is a small pinion which is operated by a worm at the end of the crankshaft which is seen projecting through the side of the base. The pinion, which rotates in a horizontal plane, is provided with a couple of pins upon which is placed one of the sets of removable cams which accompany the toy. The cams are double, being provided with two separate peripheral edges, and each edge is engaged by the short arm of a pair of levers, as shown in the engraving. The upper lever attaches at the end of its long arm to a vertical shaft, which passes up through the body of the figure, and is pivotally attached to its right arm at the shoulder. By this means the rotation of the cam causes a vertical up and down movement of the arm and the drawing pencil which it carries. The lower cam operates a system of levers by which the arm is given a series of right and left movements. It is evident that by giving the proper relative contours to the two edges of the cam, the arm, with the pencil which it carries, may be made to trace any desired line upon the paper, either vertical or horizontal, by the action of the first or second cam, or diagonal or curved, by the joint operation of the two. Each of the double cams which are provided with the toy is cut so that its operation will cause the figure to draw some well known object. The levers are kept in snug contact with the cams by a pair of spiral springs.



THE TOY ARTIST.

The easel is hinged to the base and is pressed against the pencil by means of a coil spring. It is provided with four projecting pins, upon which the sheet of paper is held while the sketch artist is at work. The model from which our engraving was made produced an easily recognized likeness of the Emperor William, of Germany (the device is "made in Germany"), and a drawing which bore a strong resemblance to the familiar barndoor fowl.

CAMERA FOR PRODUCING ENLARGED IMAGES OF MICROSCOPIC OBJECTS.

Owing to the improvements in microscope objectives and in photography, it is practicable to produce magnified photographic images of microscopical objects which are not only interesting to the microscopist, but are also of importance to the pathologist and histologist in making a record.

We illustrate photo-micrographic apparatus recently completed by Mr. O. G. Mason, microscopist of Bellevue Hospital, and for many years secretary of the American Microscopical Society.

This apparatus will receive an objective of any power, and produces images on a 3¼ by 4¼ plate. The apparatus is very compact, being only about two feet in length. It is all mounted on a single base board, so that it may be moved bodily if it becomes necessary to shift its position.

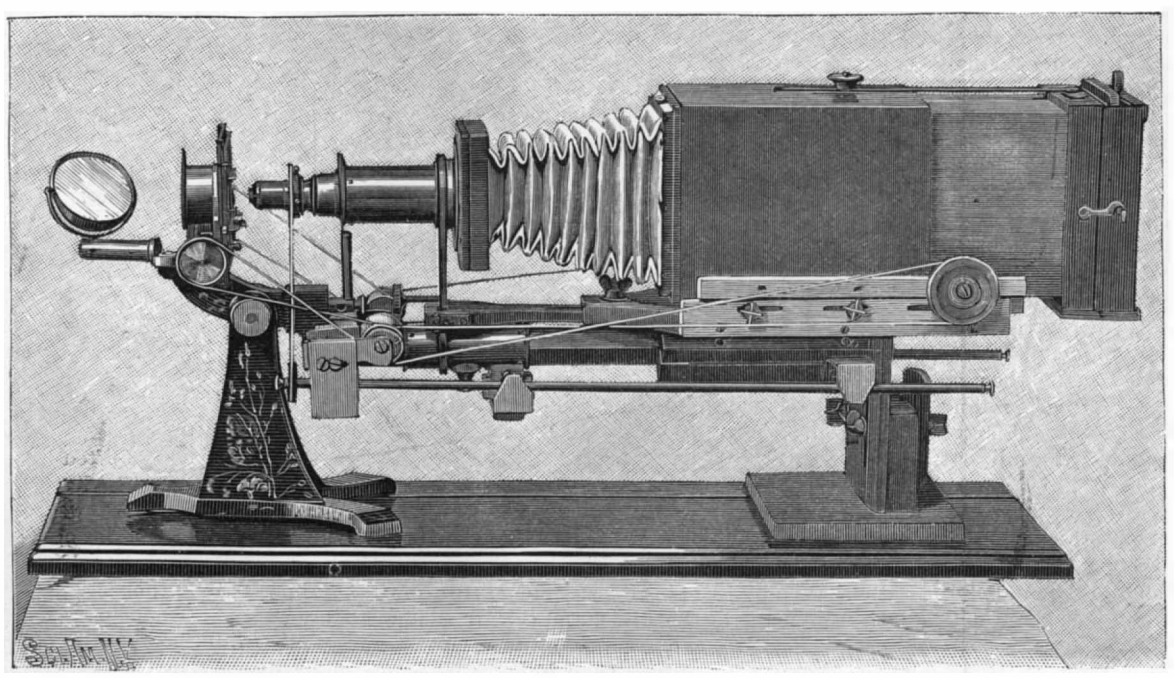


PHOTO-MICROGRAPHIC APPARATUS.

The camera box is rigidly attached to the standard of a microscope of the usual form, so that the box can be placed horizontally or inclined at any desired angle Adjustments are made which provide for any required distance between the objective and the sensitive plate, so that the desired amplification may be readily secured. The mechanical stage is operated by the small chains which extend along the sides of the frame of the apparatus, and the rotation of the objective, polariscope, etc., and the focusing are effected by rods extended toward the rear of the camera box. With these adjusments the operator seated at the camera can manipulate the instrument for focusing or searching the field for any particular object.

The instrument has been used for making negatives showing objects with a magnification of 15,000 times. All the parts are made adjustable for wear and atmospheric changes and for adaptation to various classes of work.

This photomicrographic apparatus forms an important part of the equipment of the laboratory of microscopy of Bellevue Hospital.

The Apostoloff Telephone.

In telephony, as at present practiced, the amount of space required for the various stations and exchanges, the large staff of attendants that must be employed to carry on the work of these exchanges with efficiency, and the complication of the electrical arrangements necessary to cope with a numerous body of subscribers constitute a serious practical hindrance. The capacity of a single exchange on the system now worked may be said to be limited to hundreds of subscribers, while one central station capable of dealing directly with 10,000 subscribers and putting any one of them into communication with any other would be all but a physical impossibility, owing to the huge number of contacts and connections, to be numbered perhaps in hundreds of millions, which would be required for its conduct. The Apostoloff automatic telephone is a device by which it is claimed that a station of such size is rendered perfectly feasible, because the number of contacts and connections just referred to is so far reduced as to be within workable limits, says the London Times.

In the central station each subscriber is represented by a piece of apparatus contained in a box a few inches high, which is connected by an ordinary metallic circuit to the telephone in his house or office. When it is remembered that he is thus enabled to communicate with any other subscriber without the intervention of any attendant whatsoever, it will easily be imagined that the details of the electric mechanism are very intricate and complicated. The general principle, however, is simple enough, as are the operations by which communication is effected. Ordinary telephones are used with the addition of a small piece of apparatus termed a "transmitter" or "manipulator." The face of this transmitter is pierced with three little windows or apertures, in two of which numerals appear and in the third certain service indications. Suppose a subscriber wishes to speak with No. 1,795. He presses a button under the left hand aperture until the numerals 17 appear. He then does the same to a button under the right hand window until 95 appears. These two operations have produced corresponding movements in the instrument that represents him at the central station. The positive currents sent by the left hand button have passed through a polarized relay and caused a local battery to send 17 successive currents through an electromagnet which has moved a traveling switch step by step past 16 contacts, each representing a group of 100 subscribers, until it has stopped on the 17th of the row. The negative currents have in the same way moved a second traveling switch till it is in connection with the 95th contact of the other row. The subscriber now presses another button, which causes the words "Ring up" to appear in the middle aperture. At the same time, by an ingenious electrical arrangement, the electromagnets that actuate the traveling switches are cut out and the circuit is completed to 1,795. He now rings up in the usual way, and in return 1,795, if he wishes to speak, presses one of his buttons and causes the words "Are you there?" to appear in both transmitters. Conversation is now possible. After finishing, both subscribers touch a button marked "Finish," whereupon the numbers in the windows fly back to zero, "Off" appears in the middle window, the traveling switches in the apparatus at the central station return to their initial position, and the whole apparatus is ready to be used again.

It is claimed that this invention is easily and inexpensively adaptable to existing telephone systems having complete metallic circuits, that it does away with the heavy expenses of large central and branch exchanges and of the numerous staff they necessitate, that it means a great saving of time and does not leave subscribers at the mercy of the attendants at the various exchanges, that it insures clear and loud speaking, and that it will permit of an immense expansion in the use of telephones. It is to be noted that the co-operation of the two subscribers concerned, and of them only, is necessary to establish communication, and that when once that is effected it is impossible for a third subscriber to interfere in any way without the sanction of the two who are speaking. Absolute secrecy is therefore assured.

Statistics of Convict Labor in the United States.

Commissioner of Labor Carroll D. Wright has recently issued a bulletin about convict labor in the United States. The total number of convicts in penal institutions in the various States, in 1885, was 41,887. In 1895 the number rose to 54,244. Of the number imprisoned in 1885, 1,967 were females. The number of females imprisoned in 1895 was 1,988, an increase of only 21. In 1885 the number engaged in productive labor was 30,853, 73·7 per cent of the total number, while in 1895 the number engaged in productive labor was 38,415, or 70·8 per cent. There was also a decrease in the proportion of those engaged in prison duties: in 1885 the total was 8,391, or 20 per cent, while in 1895 there were 8,804, 16·2 per cent. In 1885 the number of idle and sick was 2,633, or 6·3 per cent; 1895, 7,025, 13 per cent.

An increase in the amount of work done in penal institutions during 1895 occurred in Alabama, Connecticut, Florida, Maryland, Massachusetts, Minnesota, Missouri, New Hampshire, New Mexico, Rhode Island, South Carolina, Texas, Vermont, Virginia, Washington, and Wisconsin. A decrease occurred in Arizona, Arkansas, California, Colorado, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Michigan, Mississippi, Nebraska, Nevada, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, and West Virginia. The total value of goods produced or work done in the United States for the various States and Territories in all the State prisons and penitentiaries for 1895 was $19,042,472.

In 1885 the total wages paid by contractors and lessees for the labor of convicts, from which resulted a product of the value of $28,753,999, was only $3,512,970, or $1 of convict labor wages to $8.19 of finished product of convict labor. At the present time, in all probability, the total value of the labor expended by the convicts in the State penitentiaries and prisons of the country does not exceed $2,500,000.

THE ironwork of the dome of the Yerkes observatory is in place. It is 90 ft. in diameter and weighs 200 tons.

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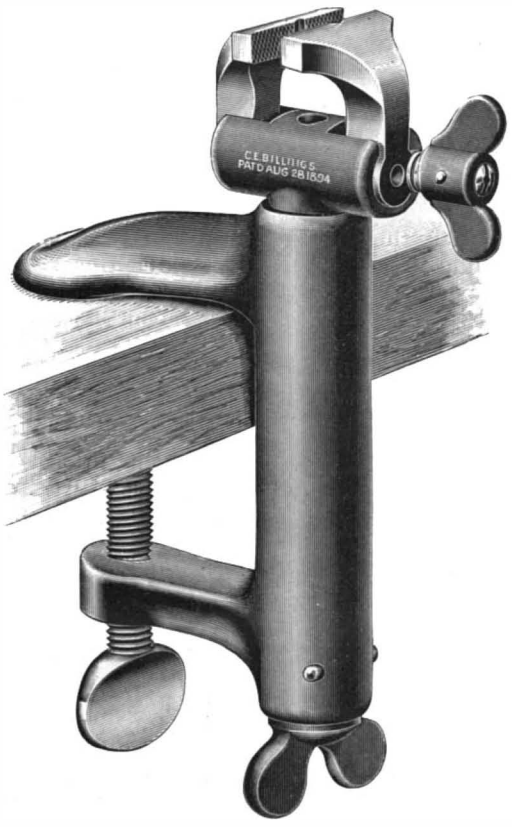
A VISE FOR JEWELERS, TOOL MAKERS, ETC.

The illustration represents a vise in which the jaws have a positive opening and closing movement in parallel lines, both jaws being simultaneously actuated by a right and left hand screw. This vise was patented by Charles E. Billings, and is manufactured by the Billings & Spencer Company, of Hartford, Conn. The illustration represents the vise held in a special form of clamp fitting it for use as a bench vise. All parts



THE BILLINGS VISE.

are drop forged of the best steel. There is a hole entirely through the vise handle, the lower part of this hole being threaded, and the vise is adjustably held in the bench clamp, at any desired angle, by means of a screw and thumb nut, a pin preventing this screw from dropping out of the clamp. The vise may thus be readily taken out and used as a hand vise, or placed in position as a bench vise. The jaws open three-quarters of an inch, and will grasp and hold central round wire from one-sixteenth up to one-quarter inch in diameter.

ELVIND ASTRUP, Peary's companion, who perished in a Norwegian snow storm last Christmas, has now a memorial stone 26 feet high erected in his memory in the forest of Holmonkollen, at Christiania.

A LOCOMOTIVE HEADLIGHT AND SIGNAL.

According to the improvement represented in the illustration, the light emanating from the lamp in the headlight not only illuminates the track in front of the locomotive, but is also utilized to illuminate signal lenses looking toward the front and to each side. The improvement has been patented by Thomas Frame, of Salida, Col. Fig. 1 shows the headlight and signal in position and Fig. 2 is a sectional plan view. In each side of the headlight casing is a compartment which has at its forward end and on the side a lens, a reflector at the rear of the compartment throwing the light rays through the forward lens, while the rays from the lamp pass transversely through the side lens, as shown in the plan view. Each lens may be screened by panes of colored glass, to signal with any desired colored light. Sheet metal flags for day signaling are also adapted to be displayed on the sides of the locomotive, between the back of the headlight casing and the smokestack, the flags being preferably made of thin metal sheets, differently colored, and each wound on a spring roller, the several rollers being journaled side by side at the back of the casing, and the free end of each sheet being drawn rearwardly and hooked on to a bracket on the smokestack. While any special flag is thus moved into position for signaling, the other flags remain wound up on their rollers.

THE BICYCLE WHEEL.

BY E. D. SEWALL.

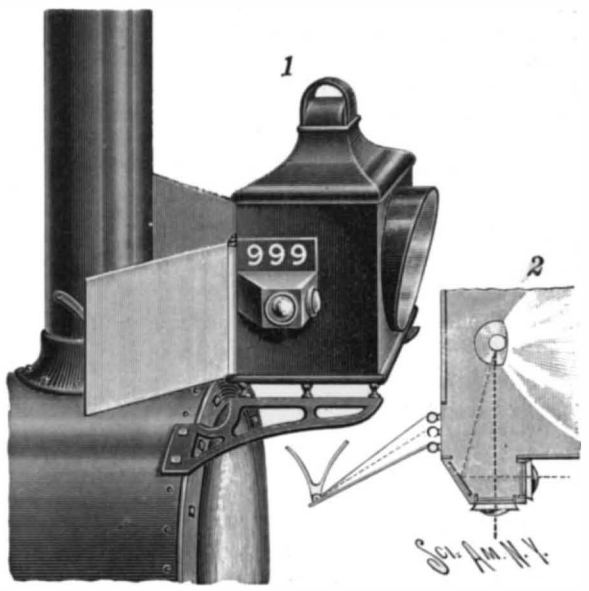
The modern bicycle is an excellent example of a meritorious invention consisting, in the language of the patent law, of a new combination of old and well known devices. There is no essential part of the bicycle that is not, in principle, more than thrice the age of the modern safety, while some of the features are inventions of previous centuries.

The wheel of the bicycle attracts the eye of the thoughtful observer probably more than any part of the machine. It illustrates perfection in principle and the utmost delicacy of the visible parts.

It is built upon the suspension principle, the load carried upon the axle being suspended from the rim, instead of being supported on the spokes that fall beneath the axle, as in the more ancient and more common form of "compression" wheel. In the suspension wheel the great tensile strength of steel wire sustains a heavy strain and yet enables the wheel to present an appearance of great delicacy. "Spider wheel" it was called in England, when it first appeared on the velocipede, and the name has not yet gone wholly out of use.

Contrary to the general opinion, the suspension wheel is one of the oldest of all the old and well known parts that enter into the combination that makes up the modern bicycle. Both England and France have claimed the honor of its invention. The cycling writers of England brought forward Edward Cowper as the first inventor, placed the date of invention in 1868, and pointed to the "Phantom" bicycle of 1869 to show it in practical use. The French replied that René Olivier, a distinguished mechanical engineer, who had experimented considerably with the velocipede, had proposed "les roues de fil de fer" in 1864, and had applied them to a two-wheeled velocipede in 1867. A search of the records of the British patent office enabled the English to establish a still earlier date, 1826, while the French did not attempt to claim back of the date of Olivier's alleged invention.

It is a fact, however, that the invention of the suspension wheel precedes the discovery of America by Columbus. The autograph manuscript left by Columbus' great countryman, Leonardo da Vinci, that universal genius, contains a sketch of a suspension wheel, and an autograph note describing the invention as one "by which wheels are strengthened and a light wheel made strong." A model of Da Vinci's wheel has been made from his sketch and placed in the National Museum at Washington. The invention antedates 1490. It is shown in one of the accompanying figures.



FRAME'S HEADLIGHT AND SIGNAL.

The next record of the suspension wheel is found in the British patent office. In 1826 a London accountant named Theodore Jones filed his application for a patent for "an improved construction of carriage wheels, of such nature that the weight they have to carry is suspended from that part of the wheel which happens to be uppermost, instead of being supported, as is usual, by the spokes that happen to be under the axle tree." The spokes of this wheel were light iron rods and the rim was a hoop of iron. The inner ends of the spokes passed through a flanged hub and were held from withdrawal by nuts screwed on their

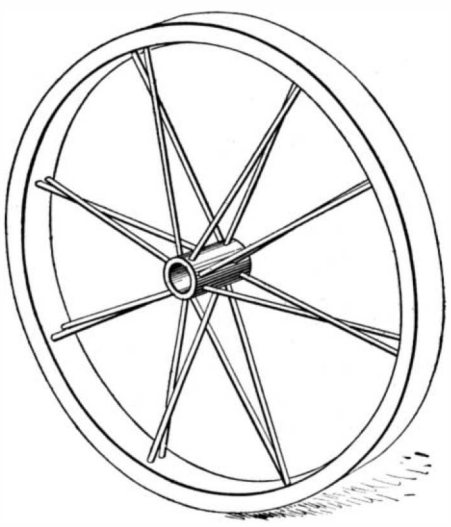


Fig. 1.—DA VINCI'S SUSPENSION WHEEL, 1490.

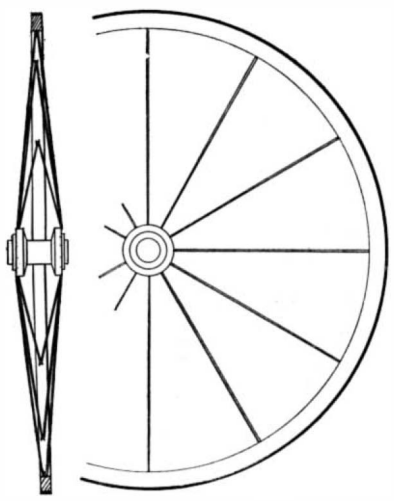


Fig. 2.—"PHANTOM" WHEEL, 1869.

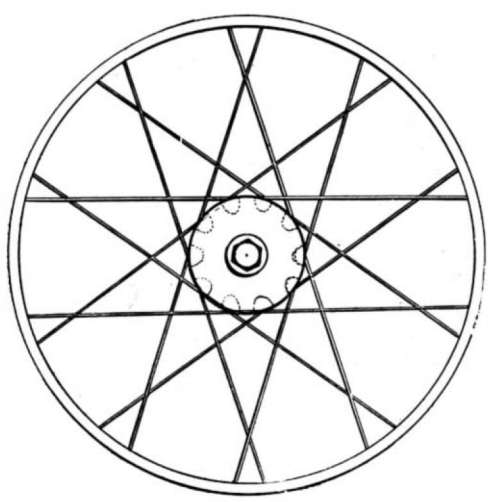


Fig. 3.—FIRST TANGENT WHEEL, 1869.

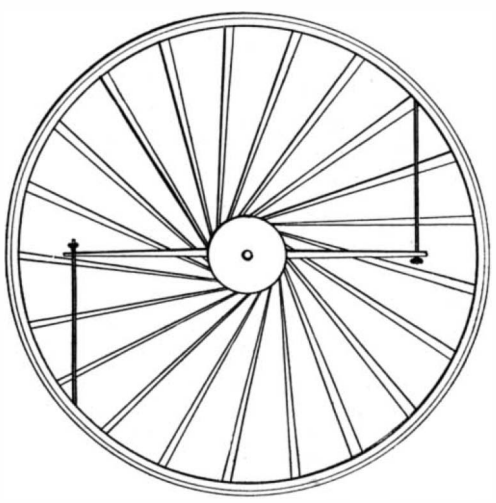


Fig. 4.—CROSS LEVER TENSION WHEEL, 1870.

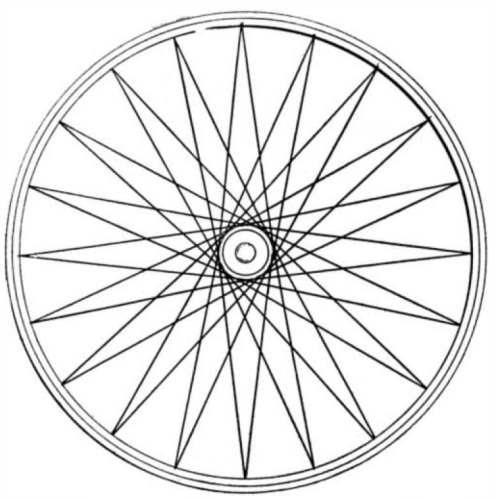


Fig. 5.—STARLEY'S TANGENT WHEEL, 1874.

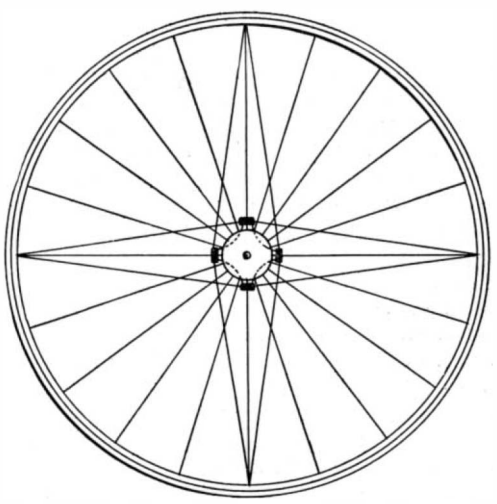


Fig. 6.—COMBINED TANGENT AND RADIAL SPOKES, 1875.

EVOLUTION OF THE BICYCLE WHEEL.

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ends. The outer ends were headed or riveted into the rims. The patent shows the wheel with a single row of spokes radiating from a single flanged hub, and also a double row converging from a double flanged hub toward the rim.

In these early inventions are found the principles and the essential features of the modern bicycle wheel. Although used to some extent on other vehicles, it was the coming of the bicycle that developed the possibilities of the suspension type of wheel. Each owes its fame in great measure to the other, and since its adoption as a part of the bicycle, "the spider wheel" has advanced in perfection with the advances in the mechanical arts and processes of manufacture, and in minor details that adapt it to its special use.

The earliest absolutely authentic application of the suspension principle to the bicycle wheel occurred in 1869. In that year William F. Reynolds and Jonathan A. Mays, of London, England, applied for a patent for a velocipede which was afterward known as the "phantom double steerer," and was widely used. Its wheels were provided with bent wooden rims and metal tires. Eye bolts were passed through the rim and tire from the inside and riveted into the tire. Suspension wires were threaded through the eyes in the rim and their opposite ends carried to opposite flanges on the hub. The ends were bent at right angles and hooked into holes in the flanges and then clamped in place. The hub was screw threaded and provided with collars correspondingly threaded, so that by turning the collars the spoke flanges could be moved apart and the spokes thereby drawn taut. In this day of the wooden rim it is interesting to note that this first bicycle wheel of the present type had rims of wood. Fig. 2 shows two views of this wheel.

The first radical improvement was the invention of tangent spokes. When the driving power is applied to the hub of a wheel and the resistance is at the rim, as in the bicycle, the tendency of the rim is to drag behind and of the spokes to wind on the hub or bend to a direction tangential to the hub. The tangent wheel was invented and the spokes were placed in the position which they tend to assume by reason of the driving strain, and hence exert a pull upon the rim along their length, thus avoiding in part the sharp bending strain on the spoke at its point of attachment to the hub. An American, Obed Look, on August 31, 1869, patented a wagon wheel which appears to be the earliest example of the tangent spoked wheel.

On August 11, 1870, James Starley and William Hillman, of Coventry, England, patented a bicycle wheel with approximately tangent spokes. They constructed a wheel with grooved rim and rubber tire, and spokes of steel ribbons secured at one end to the flanges on the hub and at the other end to the rim. Rigidly secured on the hub were two bars projecting radially in opposite directions. A rod fastened in the rim at one end extended through the outer end of each of the tension bars, practically at right angles, and a thumb nut was screwed on to the threaded end of each rod. By turning up the thumb nuts the rim would be turned relatively to the hub and the spokes drawn to tension tangential to the hub. This wheel was used for two or three years on the early Ariel bicycle, and was known as the cross lever tension wheel.

The tangent wheel, very much as it is used to-day, was patented in England to James Starley in 1874. This patent showed the hub suspended within the rim by spokes of steel wire extending in pairs from points on the rim to opposite sides of the hub flanges. In the modern tangent wheel the spokes, instead of diverging in pairs from points on the rim, are equally spaced on the rim and extend alternately to opposite flanges on the hub. Otherwise the bicycle wheel of the present is substantially similar to Starley's wheel of 1874.

The bicycle wheel has to withstand the lateral strain that tends to "dish" it, the downward strain on the axle, and the torsional strain of the driving devices on the hub. The first of these is well withstood by the truss-like action of the spokes diverging from rim to the opposite ends of the hub; the second is theoretically best resisted by a wheel with direct or radial spokes; while the third is provided against best by tangent spokes. The cross lever tension wheel was weak to withstand the dead weight of the load, although strong to resist the driving strain. Attempts to combine the good qualities of both tangent and radial spokes have been made from time to time, and a number of patents have been obtained for various combinations of the two. English patent to Carter, dated August 17, 1875, is a representative example of such a combination wheel. At the present time it is the general conclusion that a properly constructed tangent wheel is the best for bicycle construction, and yet it was not adopted to any wide extent until Americans became extensive manufacturers of bicycles. They were quick to recognize the general superiority of the tangent wheel, and to-day the use of the tangent wheel in bicycles is universal.

In the early period of the suspension wheel there was no uniformity in the methods of fastening the spokes in rim and hub. Gradually it came to be the practice to screw the spoke into holes in the hub flanges and rivet them into the rim. This caused a distinct weakness in the wheel, because the threads were liable to be stripped off. In such wheels broken spokes were frequent after a few months of wear. American makers generally adopted the method of securing spokes in the hub by heading the end of the spoke, threading it through some part of the hub and screwing the other end into a nipple inserted in the rim. English makers have now adopted the same method, and a broken spoke is a comparatively rare accident to the cyclist.

The ordinary method of securing the tangent spoke to the hub is to provide flanges on the hub, drill holes through the flanges parallel with the axis of the wheel, and thread the headed spoke through these holes and then bend it sharply at right angles so as to form a hook in the hub flange. To avoid the necessity of bending the spoke, various devices have been resorted to, such as turning the flange of the hub and crimping it, or providing projections through which it may be threaded and extended to the rim at right angles to the projection. Where there is no flange, as in some of the modern tubular hubs, the spokes are locked in place in various ways in holes drilled in the hub tube.

The first rims used with rubber tires were of solid metal grooved to receive the tire. In 1877, J. S. Smith, of London, England, produced the hollow metal rim. This was a great improvement, and in the first half of the last decade was considered one of the triumphs of cycle construction. These rims were made of lapped and brazed sheet metal in one, two, or more pieces, generally thickened or reinforced where the spokes entered the rim. In later years they were made of drawn tubing rolled into the proper shape. With the advent of the safety the hollow rim disappeared for a time, to be revived, lately, in England, where the American wooden rim has had serious opposition.

The most radical change in bicycle construction since the introduction of the pneumatic tire has been the substitution of wood for metal rims. This is a purely American innovation. About 1892 wood rims were proposed; the following year saw them in use, and in 1894 the use had become general and is now universal in the United States. The English still offer strenuous opposition to the use of them in their country, on the ground that wood rims are not adapted to their climate. From present indications the wooden rim seems likely to conquer. As stated before, there is nothing novel in the use of a wood rim on a suspension wheel. The patents on wood rims are for certain specific details of construction, such as for the character of the joint, and specific construction of rims made of strips cemented together.

The Production of Cloisonne Ware in Japan.

The production of cloisonné goods was, says the Swiss consul at Yokohama, introduced into Japan from China in the sixteenth century, and was started at Nagoya, which is still the headquarters of the industry, although it is successfully carried on at other places. Owing to the great spread of Japanese curios, favored by the fashion of the day, almost every one is acquainted with the Chinese or Japanese cloisonnés, those vases, plates, or other metal objects coated with a shining enamel of many colors, and ornamented with strange drawings and designs brought specially into relief by the colored enamels. An authority on Japanese art gives the following interesting account of their manufacture. The copper vessels are provided internally and externally with projecting rims of brass, the height of which determines the thickness of the layer of enamel with which the objects are to be coated. The outlines of the design are marked on the copper with white lead. Following the lines of this design, narrow strips of brass are bent by means of wire pliers into all sorts of small shapes over a glass plate. The strips so bent are fastened by their edges to their places on the design, at first temporarily, by means of a special cement, and later on, more durably by an easily melted solder. After this process, the surface of the vessel appears entirely covered with a network of cells. These cells are then filled out with powdered vitreous matter reduced to a paste by the addition of water; when these colored enamels are dry, the vessel is placed on the furnace for the first time. During the burning process the colors harden and sink beneath the level of the edges of the cells. All these depressions are filled up after the vessel has cooled, and it is then heated again, the process being repeated until all the cells are equally full. Finally, the surface is smoothed and polished, and receives a questionable improvement by means of vegetable wax and a coat of paint. The enamels are burnt in small vessels which are not placed in special furnaces, but have charcoal packed round them, which is fastened by wire and set alight. This apparently primitive process allows the intense heat to be suddenly withdrawn by snatching away the charcoal; this prevents the enamel, which readily liquefies, from running out of the cells, and consequently seems necessary to the success of the operation. A similar process has also been adopted within the last few decades, principally at Nagoya, for ornamenting porcelain and earthenware vessels with enamel in cells. For this purpose the surface which is to receive the enamel is left unglazed, and the solder falls away while the enamel adheres tightly to the rough earthenware surface as a kind of glazing. At the Tokio Exhibition the cloisonné makers of Nagoya were represented by numerous exhibits, some of which were very fine, but it is stated that really good specimens of this ware are very dear. Very small vessels, with the cell walls made of silver, were marked at 150 yen, rather larger ones, with splendid coloring, at 175 yen. Instead of using copper vessels, manufacturers have already begun to produce vases of solid silver; this, of course, considerably increases their cost.

The Development of Africa.

Henry M. Stanley, M.P., has written an article entitled "The Story of the Development of Africa," which appeared in the February Century. Recent events in Africa give this a particular timeliness and importance. Concerning the partitioning of the continent Mr. Stanley says: "Within the last ten years France has acquired of equatorial Africa about 300,000 square miles, in which there are now 300 Europeans; Germany, 400,000 square miles; Italy, 547,000 square miles; and Portugal has now a defined territory extending over 710,000 square miles. France, moreover, has been active farther north, in the Sahara and in west Africa, and claims rights over 1,600,000 square miles, while Germany, in southwest Africa and the Cameroons, asserts her rule over 540,000 square miles." England was the last European power to engage in the rush for African territory. Her efforts for some years after the Berlin conference had been confined to reserving spheres of influence, rather than to violent annexation, and to moderating the passion for African land manifested by Germany, France and Italy. If any power had the moral right to interfere with this fierce lust for annexation, it must be admitted that, after policing the African coasts for over half a century, exploring the interior and establishing Christian missions in East Africa, Nyassa Land and Uganda, England was fairly entitled to it. Between 1886 and 1890 Englishmen began to stir and succeeded in forming the famous South African Company, the African Lakes Company and the I. B. E. A. Company. The Royal Niger Company had obtained a charter in 1886, and in October, 1889, a somewhat similar one was granted to the South African, with administrative power over 750,000 square miles. In 1891 it absorbed the African Lakes Company, and thus British Central Africa, with 500,000 square miles, was formed. To the British East African Company was given authority over 700,000 square miles. By placing these statistics in a tabular form the reader may best see the subdivision which has taken place since February 25, 1885:

	Sq. Miles.
To the Congo State, by consent of the powers	900,000
France annexed	1,900,000
Germany	940,000
Italy	547,000
Portugal	710,000
Great Britain—	
South African Company	750,000
British Central Africa	500,000
British East Africa	700,000
Total	6,947,000

The Bloated Railway Shareholders.

Poor's last Manual shows that the entire interest paid in the United States on railway bonds and other debt, together with the dividends on stock, averaged only 2·94 per cent for 1895, while dividends on stock alone averaged only a pitiful 1·59 per cent. What farmer or other property owner would be satisfied with a return of a little over 1½ per cent a year? If it be answered that some stocks have been "watered," a liberal deduction on that score would still leave the average returns on stock bought by bona fide investors far below those to which ordinary investments are entitled. But bonds are not watered, yet the interest which they have yielded for many years has been very much less than the ordinary interest rates on the average. Poor's Manual figures that and the dividends on stock since 1890 as follows:

	1890.	1891.	1892.	1893.	1894.	1895.
Interest per cent of bonds	4·27	4·25	4·25	4·30	4·11	4·25
Dividends per cent of stock	1·80	1·85	1·93	1·86	1·64	1·50
Interest and dividend per cent stock and debt	3·04	3·06	3·01	3·02	2·89	2·94

When it is remembered also that hundreds of millions of capital stock and bonds have been wiped out of existence, and, moreover, that in scores of cases of reorganization holders of securities have been heavily assessed in order to retain some evidences of their investment and a chance of a little return in the future, it will be admitted that the railway stockholder and bondholder is not to be envied on account of the undue profitableness of his speculations.—Railway Age.

The Canals of Mars.

A telegram has been received at Boston, October 5, from the Lowell Observatory at Flagstaff, Arizona, announcing that the canals of Mars, known as Phison and Euphrates, have been observed again to be double.

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THE NEW CROTON DAM.

The water supply of New York City is derived principally from the watershed of the Croton River. When it was selected, over fifty years ago, by the authorities, it was very doubtful if they fully realized its advantages and disadvantages, yet it is but fair to say that, in spite of all that has been done and said about it and all criticisms that have been levied upon it, it has done remarkably good service during the past, and may be relied upon in the future to supply water for many years to come.

Over the area represented by the watershed of this stream an enormous quantity of water falls during the year and billions of gallons, going absolutely to waste, pour torrentlike over the Croton dam at some seasons. Long ago the original Croton Lake formed by the old Croton dam proved inadequate for impounding water, and additions have been made from time to time in the establishment of other dams, of which a number now exist.

The water for the City of New York may now be said to be stored and impounded in a succession of steps. As representing the lowest of these steps, the city and Central Park reservoirs and the new Jerome Park reservoir may be cited. By means of the old and new aqueducts, these lower steps in the series connect with the next higher one, which is the original Croton Lake, and New York's water now comes from the identical lake created over fifty years ago by the small and almost insignificant masonry dam thrown across the line of the Croton River where it passes through a defile. The Croton Lake thus established is a long narrow body of water, riverlike in character and supplied by numerous tributaries of varying importance. Going up the course of this stream upon some of these branches, we find other steps in the series where further up the stream other dams have been recently constructed, each impounding its own body of water. In this way the highest storage level is reached and the Croton system will be seen to include a number of lakes or reservoirs. all tributaries of the main Croton Lake by the natural watercourses.

The storage capacity of the old lake is placed at about one thousand million of gallons. At a point on the line of the Croton River, about three and a half miles below the location of the present dam, work is now in progress on the erection of what is known as the new Croton dam, on the Cornell site, as it has been termed, and our illustration shows the present aspect of the work as now in progress.

In a preceding issue (SCIENTIFIC AMERICAN, July 9, 1892) we have illustrated the completed structure. This dam is the outcome of the proposed Quaker Bridge dam, the gigantic structure which it was proposed to establish further down the river, and will be one of the largest dams ever erected by man.

The principal portion extends directly across the stream, its southern section being of earthwork and the higher portion to the north being in masonry. The earthwork dam contains the usual rubble masonry core, with a 6 foot crest, which crest is 5 feet above the water level, though still below the summit of the earthwork. The masonry dam varies in width at the bottom according to its height, with a maximum height of 238 feet and a maximum width of 185 feet. It is established on a level bed prepared in the natural rock, with two ditches or cuts running its length to give it a better bite upon the rock, the masonry work being carried down into these cuts.

The spillway is quite peculiar in arrangement and forms one of the characteristic features of the dam. Starting at the bottom of the northern end of the dam, it rises in a series of steps parallel with the axis of the dam, by which about two-thirds of its height is reached. Here a platform or level area is established, and from it the remaining steps of the spillway rise, their faces being nearly at right angles in direction to the main axis of the dam. The top of the spillway is 24 feet below the level of the water. The gap formed by the spillway is to be crossed by a bridge. The dam is to be 1,200 feet long and the spillway will provide a crest of 1,000 feet in length for water to escape over. This provides a factor of safety adequate for inundations many times greater than could take place under any conceivable conditions. The steps of the spillway are about 4 feet in width and 5 feet in rise.

Across the dam and bridge, a private department road will be carried, 20 feet wide, leaving a margin of 5 feet on each side for necessary railing and coping. The new dam will increase the area of Croton Lake to 7,500 acres, with a capacity of 30,000,000,000 of gallons, submerging the present Croton dam and back of it Muscoot dam, in what may be designated the upper levels of the water supply. As one of the objects of Muscoot dam, which impounds 6,000,000,000 of gallons, is to maintain an even level of water to meet the desires of the inhabitants of the neighboring country, the net or available contents of the dam may be taken as 24,000,000,000 of gallons, or over two months' supply of water for the city of New York.

M. BERTHELOT, the celebrated French chemist, has received the Grand Cross of the Legion of Honor.

Contracts Awarded for Ten Torpedo Boats.

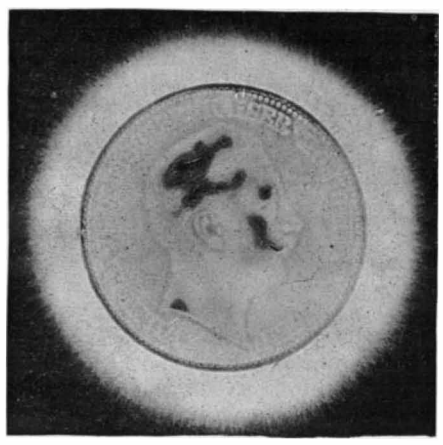
The contracts for the building of ten torpedo boats were awarded by Secretary Herbert on October 6. Four of these are to steam 20 knots an hour, three 22 knots, and three are to have the high speed of 30 knots an hour.

The amount appropriated for torpedo boats by the last Congress was $1,300,000, and the number of new boats was limited to thirteen. The total cost of the authorized boats will be about $1,100,000. Of the 30 knot boats, one, which is to be of 250 tons displacement, is awarded to the Union Iron Works, of San Francisco. The other two will be of 143 tons displacement and will be built by the Bath Iron Works, of Bath, Maine. Of the other boats, Baltimore gets one, Portland, Oregon, two, and the rest will be distributed among Eastern and Western bidders. The larger boats above mentioned are of the type known as torpedo catchers, their particular work being to overtake and sink the smaller torpedo boat proper. For this purpose they are given greater size and speed, and carry a considerable armament. The 143 ton boat will have four 1 pounder guns and the 240 ton boat six 6 pounder quick firers. It is not unlikely that they will surpass the contract speed, and by so doing prove themselves to be the fastest of their kind afloat.

PHOTOGRAPHY BY AN ELECTRIC DISCHARGE.

The discovery of Roentgen has given a remarkable impetus to electrical experimentation, especially when connected with photography. We have repeatedly given reproductions of radiographs and magnetographs. We now give a photograph produced by an electric discharge.

The subject is a German coin, and the picture was produced by an electric discharge from an induction coil, the coin having been placed on the sensitive plate and the contact having been formed by accident. We have had this experiment verified by actual trial, and



PHOTOGRAPH OF A COIN PRODUCED BY AN ELECTRIC DISCHARGE.

have found that by placing a coin upon a sensitive plate, the plate resting on a sheet of metal connected with one terminal of the coil, with the other terminal connected with the coin, a discharge of one or two seconds suffices to produce an image of the coin. Surrounding the image is a halo produced by the radial discharge.

Although images produced in this way are not new, we give this particular example on account of the completeness of the image.

Area and Population of Japan.

According to a Japanese journal, says the Journal of the Society of Arts, although it is recorded in history that the census of Japan was taken as early as 281, no figures then obtained remain on record. In the year 1720, the population numbered 26,065,422; in 1815, 25,622,000; in 1880, 35,929,000; in 1885, 37,869,000; and in 1893-94, although the exact figures are not known, it may be inferred from the rate of increase during the preceding two decades that the population of Japan at the end of the year 1894 could not have been much less than 42,000,000. As Formosa has been newly added to the Japanese territory by the treaty of peace, and more than 3,000,000 of people in Formosa have, in consequence, become Japanese subjects, the present population of the country is probably more than 45,000,000. The area of the new territory being 2,532 square ri (sq. ri = 5·9 square miles), the total area of the country, which was before the war 24,794 square ri, is now 27,326 square ri. Japan, in the extent of her territory compared with European countries, stands now next to Spain, being about equal to Sweden. She is larger than Great Britain and Ireland by 6,933 square ri, and is the eleventh largest country in the world. Her population is greater than that of France by 6,600,000, but less than that of Germany by 4,416,000. Compared with Great Britain and Ireland, she has 7,100,000 more people. In population, therefore, Japan ranks as the fifth power in the world.

Science Notes.

It has been decided to erect a statue of Jenner in Tokio, Japan.

Sir William Turner has estimated that a whale of 50 tons weight exerts 145 horse power in swimming at a rate of 12 miles an hour.

A submarine mountain range has been discovered in the southern part of Davis Strait by the Danish steamer Ingolf, which has been carrying on deep sea explorations on the Iceland and Greenland coasts for the past two years.

According to Nature, specimens of firedamp recently collected by M. Th. Schloesing, Jr., with suitable precautions, from many sources, all contained nitrogen, showing a notable amount of argon; the ratio of argon to nitrogen was, within the limits of experimental error, about the same as in air.

It appears that the specific heat of sulphur in the viscous state is distinctly higher than in the liquid state. M. J. Dussy has ascertained that if the total quantity of heat lost by one grain of sulphur in passing from a temperature T to 0° C. is plotted against the temperature, there is a distinct change of curvature at about 230° C.

A young man who had been used for about four weeks as an object for demonstrating X rays phenomena discovered to his surprise that his skin was peeling off at the places which had been exposed to the rays, causing sores in some places. He also began to lose his hair, and is now threatened with premature baldness. —Elektrotechnische Rundschau.

In a communication made by M. H. Moissan to the Academy of Sciences, Paris, the author stated that experiment had shown that the black diamond reduced to a very fine state of division, and heated in a stream of oxygen to a temperature of 200° Cent. below that of combustion of the diamond, gives off a very small amount of carbon dioxide, the diamond remaining transparent.

Herren Sarasin have recently explored the southeast arm of the island of Celebes in the Moluccas, and have discovered there two large lakes, Matanna and Towuti, at a height of 400 and 350 meters respectively above sea level. In the former a sounding of 480 meters was made without finding bottom. Remains of a prehistoric village built on piles, but now submerged, were discovered, the bronze and pottery found being very like that obtained in similar villages in Europe.

A disadvantage of the metric system, says the Observer, is found in the use of the Centigrade scale on the thermometer. Prof. H. A. Hazen points out that the degrees in this are twice too large, while weather records are complicated and filled with errors by having half the temperatures with minus signs before them. Prof. Hazen suggests that both the Centigrade and Fahrenheit scales have their zero point dropped to forty degrees below zero of the present scales. This would obviate the difficulty of the minus sign in meteorology, but the Fahrenheit degree would remain the better.

The preparations for the exploration of the South Polar regions by M. De Gerlache, a Belgian naval officer, are almost complete. The crew of the Belgica will be chiefly composed of Norwegian sailors and harpooners, but of the three officers holding responsible positions two are Belgians. Three Belgian scientific men have generously offered their co-operation and will accompany the expedition. Belgium does not furnish, however, a zoologist capable of taking deep sea soundings, and an appeal has been made in the scientific journals of England, France, and Germany for a competent man to supply the deficiency.

A paper on "The Important Relation of Plant Life to Photo-Chemical Climate," based on observations made at Vienna, Buitenzorg (Java) and Cairo, was recently presented to the Vienna Academy of Sciences by Prof. Wiesner. The measurements of the chemical intensity of light were made by a process corresponding in principle to the photographic method of Bunsen and Roscoe. The following, Nature says, are the principal results arrived at: (1) The greatest chemical intensity of light in Vienna amounted, in Bunsen-Roscoe units, to 1·500, and at Buitenzorg to 1·612. (2) The average ratio of the noon intensity to the daily maximum at Vienna was as 1 : 1·08, and at Buitenzorg as 1 : 1·22. (3) At Vienna the yearly noon intensity varied in the proportion of 1 : 2·14, and at Buitenzorg in the proportion of 1 : 124. (4) As a rule, the daily maximum at Vienna occurred about noon and at Buitenzorg in the late forenoon. This explains the relatively high maxima at Vienna and the relatively low maxima of Buitenzorg. In clear or uniformly cloudy weather the maximum occurred generally at noon at both places. (5) At Cairo a strong depression of the daily curve of intensity was observed at noon during a perfectly clear sky. This depression was also observed on rare occasions at Vienna, but to a smaller extent. (6) At Buitenzorg the chemical intensity of light was generally greater in the forenoon than in the afternoon. At Vienna this excess was greatest in June and July; the morning intensities were generally higher than the corresponding evening intensities, even when the sky was similarly clouded.

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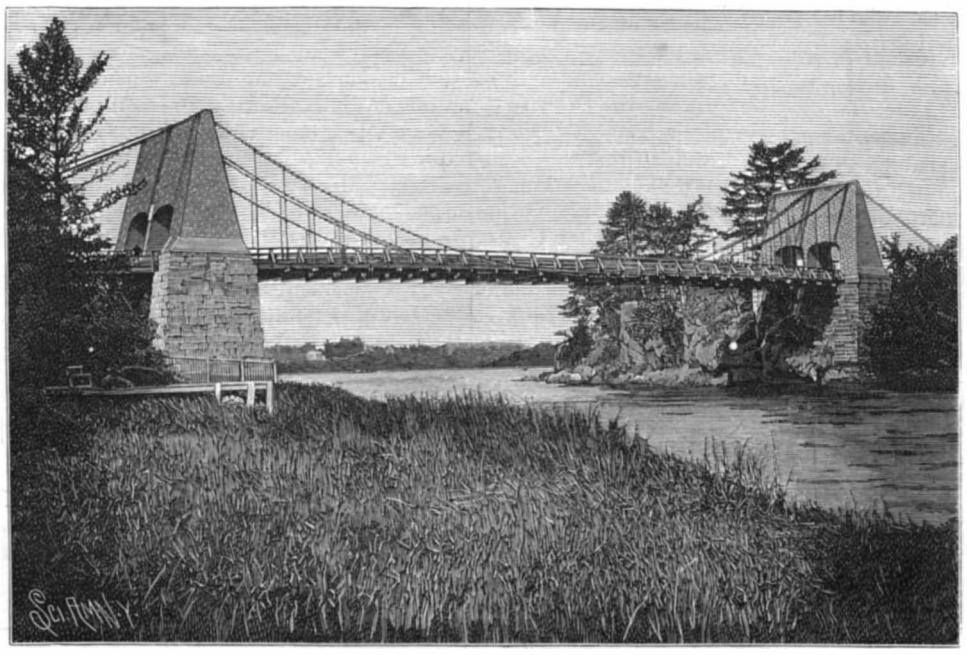
THE ESSEX-MERRIMAC BRIDGE.

BY HORACE C. HOVEY.

The Merrimac River flows for 78 miles through New Hampshire and for 35 miles through Massachusetts, and in its charming valley half a million people dwell. To-day it turns more mills than any other stream in the world, and a century ago there was more shipbuilding in its estuary than anywhere else on the continent. When it was proposed to substitute bridges for ferries a sharp controversy arose. On one side were merchants and manufacturers and such farmers as desired better means of communication. On the other were the ferrymen whose craft were in danger, the lumbermen whose huge rafts came down from the mountains to the sea, and, above all, the shipbuilders whose yards employed thousands of hands. Much was said about log jams, ice jams, and other evils, real and imaginary. Finally the party of progress won the day, and Governor John Hancock set his bold signature to bills for bridges at Newburyport, Amesbury, Haverhill and Lowell, all to cross the Merrimac. The period between 1790 and 1805 was an era of roads and bridges, during which the Legislature of Massachusetts chartered 42 turnpikes and 67 bridges, every one of which was earnestly advocated and strenuously opposed.



THE ESSEX-MERRIMAC CHAIN SUSPENSION BRIDGE.

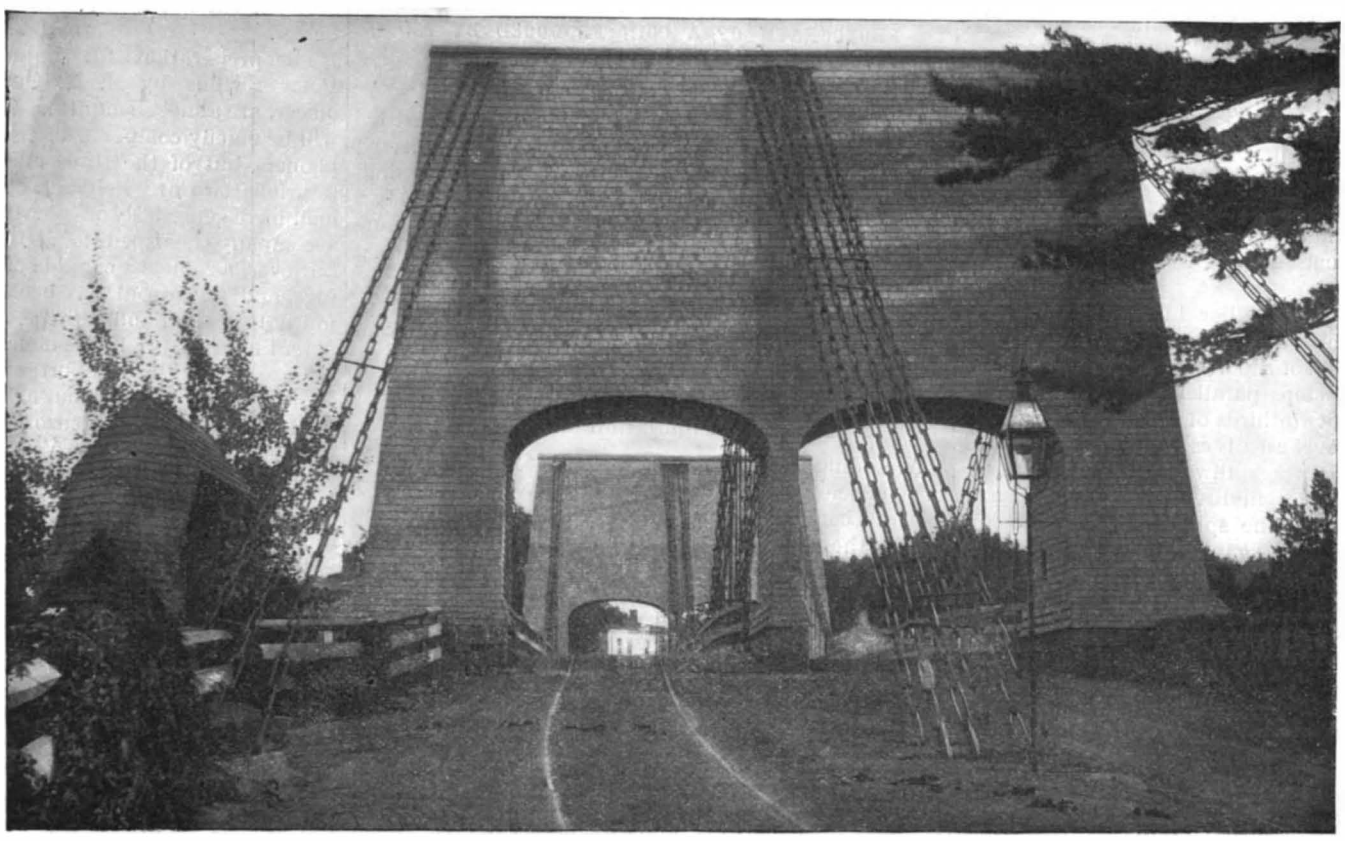
Our object is particularly to describe what is known as the Essex-Merrimac bridge, crossing at Deer Island from Newburyport to Salisbury; and which has existed in two different forms, each having a bearing on the general interests of bridge building throughout the country.

The location is extremely picturesque, abounding in cliffs, wooded islands and primitive pine trees. Deer Island is now the property of Mrs. Harriet Prescott Spofford, the poetess, who has done much by landscape gardening to improve what was already so attractive. Hawkswood is adjacent, with its elegant environs and romantic legends. Near by the southern shore once stood the manse of Rev. Matthew Plant, a protege of Queen Anne; and a stone wall still stands that was built by his negro slaves imported from the Barbadoes. The fact of main interest is that the river here is 1,000 feet wide, deep enough for the largest vessels, its current strong, and its bottom extremely rocky.

Severe conditions were imposed that were meant to be prohibitory. One of them was that the span of the main arch should be 160 feet, or three times as great as any other then in America. This was met by what was known as Palmer's arch, invented and patented by Timothy Palmer, an architect of Newburyport, and which was afterward used for a span of 194 feet over the Schuylkill, and for one of 244 feet over the Piscataqua—the figures as given by Mr. Palmer. For this invention he got a gold medal and $100 in cash. What he did was to imitate in timber the familiar voussoir of the stone arch, by means of king posts ten feet apart, in radii of a circle of which the curved timbers which they joined formed the circumference. Each quasi-voussoir was further strengthened by cross braces and curved planks. There were three such frames, one on each side and a third down the middle; the result being an extremely strong arch.

Solid piers of logs built in cob house style, filled with rock, occupied fully half the water space. The portion of the bridge from Newburyport to Deer Island was 438 feet long, and that from the island to Salisbury 592 feet; the entire length, including the approaches, exceeding 1,000 feet. The total amount of timber used was 6,000 tons, of which only about 1,000 were in the bridge itself, the remainder being in the enormous log piers. From that quantity of material twenty ships of the old style could be built; and had the logs stood end to end, they would have reached 50 miles. The exact cost of the bridge was $36,398. The receipts from tolls in the last year of its life came to $5,553; the charges being one shilling and sixpence for a chariot or other vehicle, twopence for a horseman, and two-thirds of a penny for a foot passenger; the latter being equal to an English halfpenny, or to one cent in federal currency. In 1809 it was decided that the Palmer bridge was unsafe and it was sold at auction, to be taken down as soon as another could be built in its place. For the foregoing facts we are mainly indebted to researches just made by Hon. O. B. Merrill.

The new Essex-Merrimac bridge was hung from chains—an invention patented by Mr. James Finley, of Fayette County, Pa., in 1808, who in that year built one on that plan over the Schuylkill. This, as we are informed, has since been taken down; which would leave the Essex-Merrimac chain bridge, built in 1810, as the oldest suspension bridge in the United States. The contractor and superintendent was John Templeman, Esq., of Washington, D. C.; the master carpenter was Samuel Carr, of West Newbury; the blacksmithing was done partly by Mr. Hall and partly by Mr. Williams. The woodwork was wholly rebuilt in 1869 under the supervision of Mr. B. F. Stanley; but the iron work remains to-day as originally put in, except for occasional repairs. In 1885, and again in 1896, official inspection was made as to the strength and security of the structure; the last time by a special legislative committee, to ascertain if the bridge was strong enough to carry the electric cars that have for some time been running over it. The conclusion was that it will stand any strain to which it is likely to be subjected under legitimate conditions. The only disaster that ever befell it was in the intensely cold winter of 1827, when the accumulation of snow and ice hindered the free play of the links, also causing the chains to rest unevenly. Four of them gave way under a heavy load drawn by six oxen and two horses and driven by two men. The men and one horse escaped, but the other animals were drowned. No fears are felt of any repetition of such a mishap. The chain bridge consists of a single arch of 226 feet span, with 40 feet as its greatest elevation above the river. The abutments are 49 by 25 feet at the base, and are 37 feet high; built of rough split granite, each block weighing one or two tons, and all firmly united by iron bolts. The quantity of stone used was 4,000 tons. On the abutments stand framed towers of stout oak timbers, capped with saddles to support the chains whence the flooring is suspended by a series of stirrups. The bridge was originally single, but is now double, with two arched entrances at each end. There were at first ten chains, but there are now twelve, in four groups of three chains each, and each group is held from swaying apart by numerous iron dogs and other contrivances. The material is the best Norway iron, in bars an inch square, bent into links each 3 inches wide and 26 inches long. Each chain is 516 feet long, measuring 256 feet along the catenary curve between the towers, the sinking of said curve being one-seventh of the length of the span. The entire weight of the twelve chains is about thirty tons. The chains are tripled as they cross the saddles at the top of the towers. On reaching the ground their ends are made fast by shackles to links that project from a network of subterranean chains, which slope for 29 feet as the cables descend from the tower, and then sink vertically for more than 10 feet. Each link holds two, three, or more links, the last in each series being driven between two blocks of stone and secured by a transverse iron bar. Thus an enormous claw is made, each link in which helps all the rest, evenly distributing the strain over the entire abutment it grasps. Mr. Stanley, who has inspected this peculiar anchorage, says that every link is embedded in puddled clay so hermetically as to prevent corrosion, the calipers showing no sign of shrinkage during all these years. We are also assured by Capt. C. M. Pritchard, superintendent of highways and bridges for Newburyport, that the average annual cost of repairing the iron work has not exceeded five dollars during the past ten years. He regards the bridge as in every particular a model of ingenuity and a safe as well as elegant specimen of art handed down to us from the first decade of this century.



ANCHORAGE OF ESSEX-MERRIMAC CHAIN SUSPENSION BRIDGE.

The whole weight commonly supported does not exceed 150 tons, whereas the bridge was calculated to support fully 456 tons. Its extreme flexibility is not regarded as a source of danger, provided that the cars pass at a moderate rate of speed, as they are always required to do.

It will be understood by the reader that the chain bridge is only from Newburyport to Deer Island, the connection between the island and the Salisbury shore being by a truss bridge of modern style with an ample draw for shipping.

The usefulness of the Essex-Merrimac bridge, as a whole, is proved by the fact that, during its existence as a toll bridge, the total receipts were $302,276. In the year 1868 it was bought by Essex County for the sum of $30,000. A large additional sum was expended in repairs and improvements, and it was made free to

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the general public. Another proof of its utility is the fact that it has been taken as a model for so many other bridges elsewhere. It is of interest, in this connection, to note that, in 1828, a second great chain bridge was constructed between Newburyport and Salisbury, at a point below Carr Island, with five spans, the longest being about 150 feet, and the entire bridge measuring 1,000 feet. It was subsequently bought by the Eastern Railroad, and removed, with the exception of the massive granite piers, to make room for a structure on another plan better adapted to the purposes of the railroad. Thus the old Essex-Merrimac chain bridge is left as the solitary specimen in New England of a style of suspension bridge that has served its intentions admirably, and may still be found preferable to the wire bridges under certain circumstances.

THE DION, BOUTON & COMPANY TRICYCLE AND THE BOLLEE CARRIAGE.

The newspaper advertisement of the Michelin combination offering 100 Dion, Bouton & Company tricycles and 200 Bollee carriages for sale at auction has called attention again to these vehicles, the manufacturers of which were the first to solve the difficult problem of devising an automobile locomotive apparatus for one or two persons that should be simple, strong, and of a sufficiently low price to bring it within the reach of those who hesitate to spend eight hundred or a thousand dollars for such an object.

We think it well, therefore, to give a description of the tricycle as well as of the carriage.

The Dion, Bouton & Company Gasoline Tricycle (Fig. 3).—The frame of the machine is the same as that of an ordinary tricycle, and upon the rear tube is bolted the motor, with a special suspension designed to deaden vibrations. The motor is vertical, has a single cylinder, makes four revolutions and is of about one-fourth horse power. The cooling of the cylinder is effected through numerous transverse projections. The motive parts, connecting rod and crank, move in a reservoir containing oil. The driving axle, at its place of exit from the reservoir, carries a pinion that engages with a wheel keyed upon the rear axle of the machine.

The gasoline is contained in a polygonal reservoir, A, of a capacity of from two to three quarts, situated under the saddle, and which at the same time performs the office of a carbureter. To this effect, it is provided with two cylindrical cocks, a part of the surface of the first of which (that to the left) is formed of wire gauze that displaces itself opposite an aperture through which filter the air and the vapors of gasoline that constitute the detonating mixture. The composition of the mixture may be regulated by the different positions of the cocks. From the first cock, the mixture passes into a second or distributing cock controlled by the handle, J, mounted upon the horizontal tube of the frame, and which sends it to the motor through a tube that traverses the carbureter. The latter is completed by a chimney, I, whose height is regulatable according to the level of the gasoline, and which serves to lead air to the surface of the latter in order to quicken the evaporation.

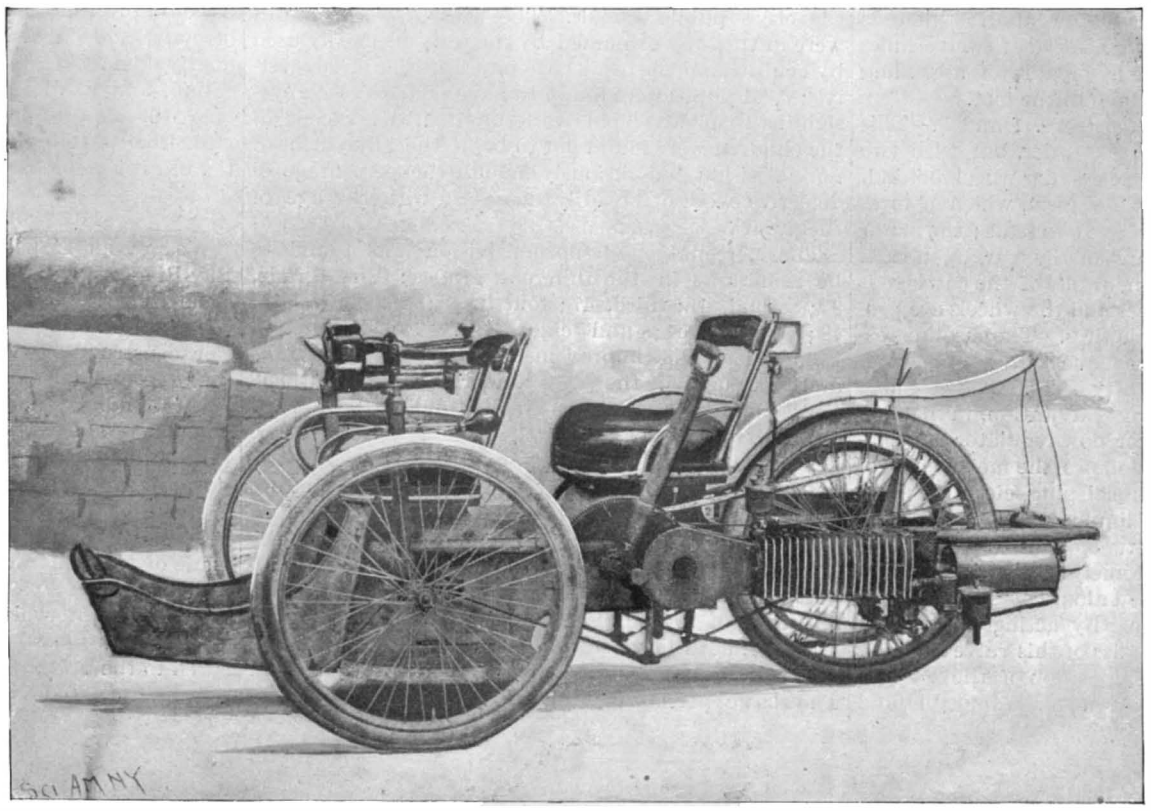

Fig. 1.—THE BOLLEE GASOLINE CARRIAGE.

The detonating mixture enters the cylinder through an ordinary clack valve placed upon the side in the valve box, and which opens automatically under the influence of the suction. After the explosion, the gases make their exit through an eduction valve controlled by a cam fixed upon the driving shaft. The eduction pipe divides into two parts, one of which runs directly into an exhaust consisting of a simple cylinder, fixed under the tube that carries the motor and provided with three orifices for the escape of the gases; the other part is continued by a worm that extends through the entire length of the carbureter and serves to reheat the gasoline.

The ignition is effected through two accumulators inclosed in a box, F, fixed under the horizontal tube of the frame. These accumulators are charged to about two amperes, and suffice, despite their small size, to give a useful effect for a continuous run of 100 hours. They are recharged by means of three bichromate batteries.

The electric circuit of the tricycle is established in the following way: The wire starting from the positive pole of the accumulators is screwed to one of the terminals of the handle bar, and thence passes into the interior of the latter as far as to the handle, M, which performs the office of a commutator. It is afterward fixed to a terminal near the preceding and then runs to the Ruhmkorff coil that is situated to the right beneath the large rear tube. The negative wire runs directly from the accumulators to the coil. The wire starting from the bobbin and ending in the explosion chamber enters the latter through a porcelain ignition tube screwed into the wall. The spark forms between two platinum wires, one of which constitutes the extremity of the wire of the coil and the other is simply fixed to the side of the motor.

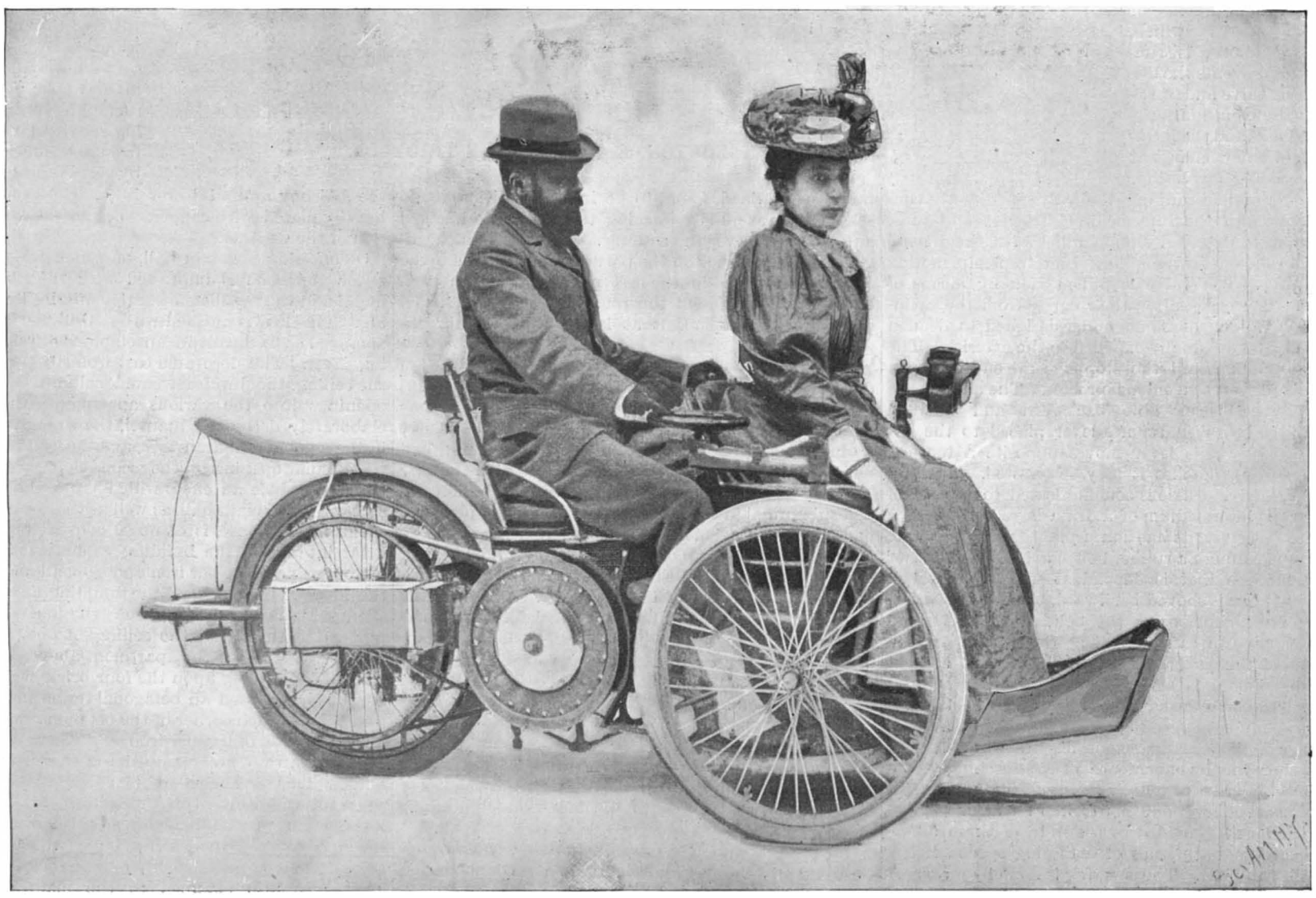

Fig. 2.—VIEW OF A BOLLEE CARRIAGE IN SERVICE.

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A reference to the figure will show that the machine is provided with pedals. These actuate the pinion through the intermedium of a ratchet wheel, and, therefore, act in but one direction and only as long as the motor is not revolving faster than they. They produce their effect only upon steep gradients, while the motor is running slowly and it is desired to aid it in making a difficult passage.

This machine, which weighs but a hundred pounds in running order, easily reaches a speed of twelve miles an hour on level ground and is capable of ascending gradients of two-thirds of an inch to the foot.

The Bollee Gasoline Carriage (Figs. 1 and 2).—This machine is likewise of the tricycle order, but with two steering wheels in front and the driving wheel behind. It is characterized by a very low form, which assures great stability. In front there are two seats; the motor and the gasoline reservoir are in the rear, upon each side of the driving wheel. The frame of the carriage is formed entirely of hollow tubes and the wheels are provided with Michelin pneumatic tires. The gasoline reservoir has a capacity of seven quarts, a supply sufficient for a run of more than fifty miles. The gasoline descends to the carbureter by gravitation, in passing through a Panhard & Levassor flow regulator containing a hollow brass float that follows the movements of the liquid, and, through a conical plug, closes the inlet orifice when the influx of the liquid is too great. The gasoline entering the carbureter spreads over a bronze cap and is reduced to an extremely fine state of division, and in this form is carried along by a current of air regulated by a clack valve. By acting upon a rod, it is possible to uncover the holes of this valve more or less, and thus modify the composition of the gaseous mixture in such a way as to render it explosible, and so that the work produced by the explosion shall suffice to cause the motor to run under normal conditions.

The ignition is effected by means of a platinum igniter heated by an external burner.

The motor is of the normal type of four revolutions. It develops two horse power. The cooling is effected through heat radiators that are clearly seen in Fig. 1. The connecting rod and crank move in a bath of oil, as in the Dion, Bouton & Company tricycle. The velocity of the motor is regulated by an apparatus that acts upon the eduction valve, which, when the motor is running wild, prevents the lifting of this valve and consequently the expulsion of the burned gases and the introduction of a new charge at the succeeding revolution.

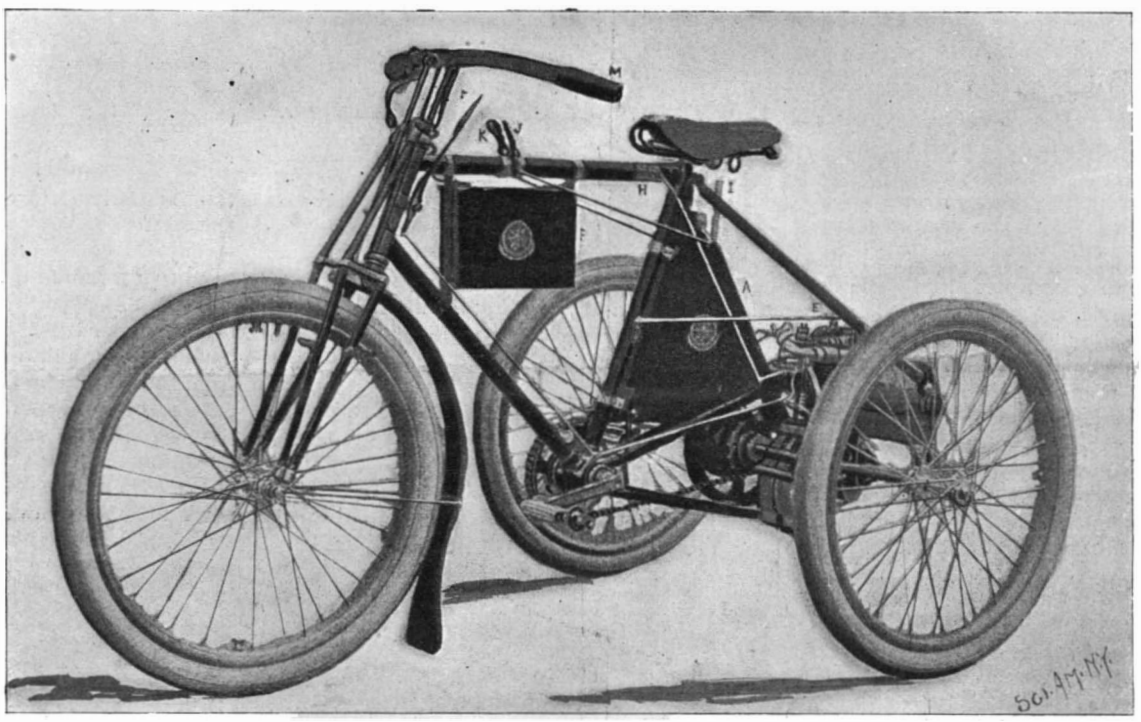

Fig. 3.—THE DION BOUTON & CO. GASOLINE TRICYCLE.

During a normal running the valve is directly controlled, through the intermedium of levers and rods, by a box fixed upon an axle parallel with the driving one. This box actuates a link that transmits motion to the valve. The valve is pulled back by means of springs. The gases, after their egress from the cylinder, pass into an eduction cylinder designed to deaden the noise, and are finally expelled to the exterior. The setting in motion and the stoppage are effected by a special and very ingenious process. The axle of the driving wheel is movable backward and forward through the intermedium of a lever placed to the left of the driver. This lever moves opposite a toothed sector, at whose notches it may be arrested. The motion of the driving axle is communicated to the wheel through the intermedium of a drum keyed to a hollow shaft that receives its motion from the driving axle. This drum, through a rubber belt, carries along another and larger one that is dependent upon the wheel. When the lever is shoved backward, the driving wheel moves forward and loosens the belt, which is then no longer capable of carrying along the wheel. At the same time, the latter applies itself against a fixed brake block and is arrested on the spot. If, on the contrary, the lever is shoved forward, the wheel moves backward and stretches the belt, and an opposite effect is produced. This arrangement has the advantage of suppressing the inconvenience of a stretching of the belt, since, in order to tauten it, it suffices, upon starting, to push the lever one more notch forward.

The carriage is provided with a train of three differential gearings that permit of obtaining speeds of 5, 9 or 15 miles an hour. The steering is done by means of a winch, which, through the intermedium of a rack and pinion, acts upon the wheel to the right. The motion is transmitted to that of the left through a cranked axle.—La Vie Scientifique.

The Eyesight of School Children.

Public Opinion has gathered from various sources, for which they give due credit, the following interesting facts relative to the defective eyesight in children and young people:

Acting under authority of the school board and with the direction of a committee of oculists, the Baltimore school teachers tested the eyesight of the children of the city's public schools. The eyes of 53,067 pupils were in this way examined by the tests ordinarily used by oculists and the results are interesting and suggestive; 9,051 pupils were found to have such defective eyesight as to make school work unsafe; 53 per cent of the children were found not to be in the enjoyment of normal vision, but curiously enough the percentage of defective eyesight steadily decreased with the age of the pupils.

The percentage of normal vision was found to be as follows in the different grades: First grade, 35; second, 41; third, 47; fourth, 49; fifth, 48; sixth, 48; seventh, 54; and eighth, 56. No explanation is offered for this improvement in eyesight with age and the use of the eyes under school conditions. Until such explanation is given it might be argued either that the eyesight of the race is deteriorating, being worst in children latest born, or that there are defects in vision which are remedied either by nature or art.

It was found that many blackboards and maps in the schools were not placed in the proper light, and the report of the oculists recommends yearly examinations hereafter of the pupils' eyesight, and that a uniform system of adjustable seats and desks be adopted and that these be regulated to the heights of the children. The large percentage, nearly one-fifth of the total number examined, found to be in no condition to do school work at all is a warning to parents and school authorities all over the country. It shows great negligence and ignorance on the part of parents, where the responsibility rests in the first place, and where periodical examinations of the pupils' eyesight by school authorities will place it at last.—Philadelphia Inquirer.

A report has been presented to the British education department by Brudnell Carter on the vision of 8,125 children attending 25 elementary schools in London; 3,181 children, or 39·15 per cent, were found to have normal vision in both eyes; 1,016, or 12·5 per cent, had normal vision in the right eye and subnormal in the left; 700, or 8·6 per cent, had normal vision in the left eye and subnormal in the right; and 3,228, or 39·7 per cent, had subnormal vision in both eyes. Comparing the sexes, the total was made up of 3,928 boys and 4,197 girls; of these 43·7 per cent of the boys had normal vision in both eyes and 33·4 per cent of the girls. Mr. Carter is of the opinion that the eyes of London school children generally are not in any way injuriously affected by the conditions of elementary school life. Myopia is not of frequent occurrence, and Mr. Carter has failed to find any evidence of its progressive increase from younger children to the elder ones, or any correspondence between the degree and the prevalence of the defect and the quality of the lighting in the schools where it was found. He holds that the prevalence of subnormal vision is due to the fact that children so rarely look at distant objects.—Science, New York.

One of the common causes of pain above the brows is the overuse of the eyes and the strain of accommodation in constantly looking at near objects. This pain, familiar to most people, is more readily excited and permanently developed among the children in the public schools and the girls of the high schools. The ocular headache is often coexistent with the anemic headache, especially in growing girls. Here is found a complication of all kinds of nervous misery, due to the eye strain associated with the vertical pain felt over the top of the head, all this being characteristic of bloodlessness. To combat this anemia, there is nothing like plenty of out-of-door exercise and wholesome food. While the practice of looking at distant objects and—unhappily—the use of appropriate spectacles may relieve the headache of eye strain, reading, writing, and sewing will permanently damage the sight; so that for the sake of education, and in the struggle for existence, the coming race will have to look out that it does not become altogether purblind. The suggestion may be pessimistic, but it is none the less timely.—Minneapolis Times.

THE POULSON METAL HOUSE.

We present two illustrations of a house erected at Bay Ridge, N. Y., for Mr. Niles Poulson, which presents some remarkable features obtained by the unusual combination of iron and copper for exterior and interior construction and ornamentation. The methods used represent the ideas of the owner in securing a fireproof building and in making use of galvanoplastic metal to produce striking effects.

In building the exterior walls of the house the foundation was prepared in the usual manner and topped with a stone belt course extending entirely around the house. Upon this was erected a wrought iron skeleton made of tee and angle irons placed some four or five feet apart.

At proper intervals from the belt course to the main cornice were placed 4 × 4 angle irons, which were secured to the upright framing. At each sill and lintel course was placed a horizontal angle iron extending entirely around the building, and above the window sill was another for receiving the floor construction. The angle irons were covered with pilasters made of deposited copper, embellished with designs of an attractive character. The pilasters were first riveted to the angle irons in such a way as to leave at each edge a flange, to which were riveted the copper panels carrying ornamental designs in bass relief. After the copper panels were put in position the entire copperwork was backed up with an eight inch brick wall, extending from the foundation to the roof. The latter is covered with red tile, and the tower which is covered with the same material, terminates in a copper finial. The roof of the veranda, extending across a portion of the front and side, is supported by cast iron columns, while the balcony around tower is made of cast iron and heavily plated with copper, so as to withstand the action of the weather.

On entering the main hall, of which we show an interior view, one is impressed with the liberal use of metal and the peculiar formation of the floor and ceiling. The floor is finished with delicately tinted tile, so arranged as to constitute an elaborate design of striking effect. The decorated cast iron ribs, arched across the ceiling, the bronze treated columns between the openings into the various apartments, the rich and elaborately decorated mantel, the wrought iron work in the semicircular archways, and the iron railing about the circular opening on the second floor, are a combination to produce an effect which is peculiarly striking. The ceiling of main hall, as well as that of all the other rooms in the house, is of novel construction, and is of great interest to the building trades. It involves the use of ordinary flat bar iron and cement, and represents the ideas of the owner of the building as to what constitutes absolutely fireproof construction. The scheme pursued is such that the ceiling of one room is the basis of the floor of the apartment above. The ceiling is made by placing upon the four brick walls of which a room is composed an octagonal frame made of angle iron. From each corner of the octagon are sprung two arches, or ribs, of flat bar iron, and where the bars cross each other they are clamped together with V-shaped bolts. This arrangement leaves a small octagonal space in the center of the ceiling, formed by the intersection of the bars already referred to. This space is covered by shorter bars, which are arched across from corner to corner of the central octagon. These are also clamped to the main bars by V-shaped bolts, thus forming a complete dome of wrought iron. The construction is such that any pressure from above only tends to make the con-

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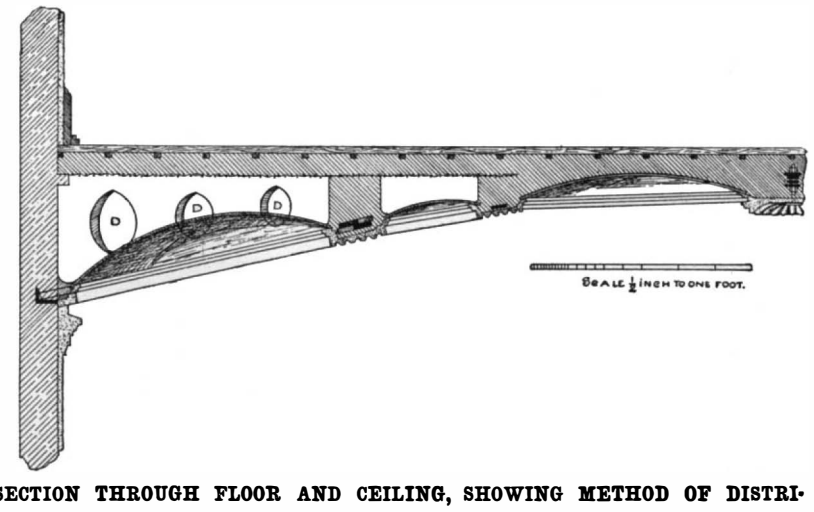
struction more secure, the strain on the bars being taken up by the octagonal frame. After the latter has been put in place the four corner spaces and the triangular spaces between the bars are filled by domed panels of plaster of Paris and cement one inch thick. These panels were formed by means of an India rubber bag inflated with air and stretched on a frame a trifle larger than the size of the panel desired. This was then pressed from the under side up against the iron ribs, permitting the air of the cushion to form a perfect dome to the opening in which it was placed. Plaster of Paris was then poured over this cushion and allowed to set. The bag, or cushions, were then used in the same way in connection with the other spaces until the ceiling was complete, giving a groined arched ceiling of strong and attractive construction. After the under side of the ceiling was finished, what may be termed ribs of cement were built up on top of the flat iron bars, as shown in the sectional view through ceiling and floor. These cement ribs were made by placing two boards parallel and filling in between them with cement and concrete. Before the cement, however, was put in, round wooden blocks slightly tapering were placed at intervals between the boards, so that when the cement was set, the boards were removed, and the round blocks taken out, there was left a series of openings in the cement ribs, as shown. These openings, or portholes, as they are called, are made use of in connection with the heating and ventilation of the house, and will be referred to later on. After the ribs were built, heavy wire was stretched over them from all sides of the room.

Another very interesting feature in connection with this house is the method employed for the heating and ventilation. In the basement is a hot air furnace provided with a coil, so that both hot air and steam can be used in warming the rooms. The air is taken in from the outside of the building and distributed to the floors of the various rooms by the method above described. The peculiar construction of the floor, with the portholes in each rib of cement and concrete, allows the hot air to pass from the furnace pipe through the various spaces formed by the plaster of Paris panels, and thus circulate under the entire floor before entering the rooms through the register placed in the floor or side wall. The result is to make the cement floor a huge radiator, thus keeping the apartment at a comfortable temperature at all times. The heating is also accomplished by leading fresh air in from the outside, passing it around the firebox of the open grates (there is an open fireplace in each room), through perforated plates, which extend across the air flue, and then introducing it into the room through openings just above the mantel.



SECTION THROUGH FLOOR AND CEILING, SHOWING METHOD OF DISTRIBUTING HEAT UNDER THE FLOOR SPACE.

Our illustrations are taken from the Building Edition of the SCIENTIFIC AMERICAN of July last, in which more complete illustrations and details are given.

IT is proposed to establish a series of meteorological stations at different points on the Jungfrau Railway, so that it will be possible to study the relations of temperature, etc., simultaneously at different altitudes. The observatory on the summit will cost $20,000.

Is Insanity Due to a Microbe?

The number of diseases which are due to the presence of bacteria in the human system has steadily grown during the last few years. The typhoid fever microbe, the diphtheria microbe, the cholera microbe and the consumption microbe are all distinctly recognized by experienced bacteriologists. With some maladies, moreover, such as smallpox, the disease germ can be so modified in character by being cultivated in the blood of one of the lowest animals that it can be used for curative purposes, or at least to render human beings proof against the more virulent germs. Now, two physicians connected with a hospital at Ogdensburg, N. Y., suspect that certain forms of insanity are also due to a particular microbe, says the New York Tribune. Drs. P. M. Wise and Warren L. Babcock are the men. They received a hint of this theory from a foreign scientist, Dr. Galceran, of Barcelona, Spain; but they have been experimenting with patients in their own hospital, and in consequence are inclined to adopt the opinions just mentioned.

They took a person who was suffering from acute delirium, inserted a suction needle into the membranes beside the spinal cord, down near the waist, and extracted a little of the moisture which is usually found there. These membranes, it should be explained, are continuations of membranes around the brain, and the fluid in the two places is considered identical. That which was extracted by the needle was supposed to contain bacteria. At any rate, rabbits which were inoculated therewith became sick, although it is not alleged that they were insane. It does not appear distinctly, either, that Drs. Wise and Babcock have been able to find and describe any particular form of microbe as belonging to delirium. Their case is not yet proved. Much less have they shown that acute mania can be cured by inoculation with modified germs. But they are continuing to work along that line of inquiry, and hope to make some further discovery which will be a practical benefit to mankind.

IRON AND COPPER IN HOUSE CONSTRUCTION AND DECORATION—MAIN HALL, SHOWING METAL CEILING AND WAINSCOTING.

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RECENTLY PATENTED INVENTIONS.

Engineering.

PROPULSION OF MARINE VESSELS.—Eugene Duerr, Buffalo, N. Y. This invention provides a method of propelling vessels designed to facilitate obtaining a high speed at a low cost for fuel, the invention consisting of a revoluble shaft projecting at the bow and carrying one or more spiral tubes. On the extreme front end of the shaft is a small propeller wheel to push floating objects out of the way, and at the stern of the vessel is a propeller with which the motor may be connected if desired, though the spiral tubes, screwing into the water at the front, are principally relied upon for the propulsion of the vessel.

Railway Appliances.

EXTENSION STEP FOR CARS.—Walker Y. Carlton, Centralia, Va. This step is designed to be readily put in position for service when needed and automatically folded when the train starts. It is held on a frame mounted to slide on the rear of the ordinary car step, a tripping device releasing the step from its folded position and letting it slide down by its own weight to the lower position in which it is adapted to facilitate the exit and entrance of passengers from and to the car. Connected with the step is a lifting device controlled from the car axle, and when the car starts from a station the revolutions of the axle cause the step to be folded up under the lowermost tread.

RAILWAY TIE AND CLAMP. — Peter Keshner and Henry Laux, Carlyle, Ill. The clamp provided by this improvement is interchangeable, or adapted for use on either side of a rail, and the clamp and tie are of simple, durable and inexpensive construction. The tie is preferably of thin plate steel, semi-cylindrical, and has outwardly extending base flanges at its sides, forming a solid foundation and keeping it from sinking into the roadbed, its open ends allowing it to be filled with dirt and made practically solid. The clamp has its inner surface conformed to the tie and has a jaw to engage a rail, a flange also engaging the top and edge of the tie flange. The two clamps of a pair are secured in place by bolts which pass through the body portions of the clamps and transversely through the tie.

Electrical.

TELEGRAPH SOUNDER.—David M. Dunn, Abingdon, Va. This improvement is designed to dispense with the local battery and extra sounder magnets at each station, enabling the ordinary relay with its relatively feeble power to produce a loud and distinct sound without impairing the efficiency and certain action of the relay armature. The invention comprises an attachment to be placed on a relay already in use, there being connected to the relay armature a broad, flat and thin plate held rigidly at one end and concaved or buckled in the center, so that when it is deflected by the slight power of the relay armature it will emit the cry of a buckled sheet of metal, changing its plane with a click producing a sound wave of considerable volume and intensity.

SIGNALING APPARATUS.—Adolph Gaiing, Carlstadt, N. J. This is an apparatus more especially designed to prevent head collisions on trolley and other railroads, and the invention consists principally of an electro-magnet at each end of a section and a signal-carrying circuit wire leading from each magnet to the other end of the section, to connect with a ground contact point adapted to be closed by the armature of the electro-magnet at this end of the section, the current passing through the circuit wires containing the signals being controlled by a part carried by the car. The signal boxes are designed to have each a night signal in the shape of a red electric lamp and a day signal in the shape of targets having "safety" or "danger" positions.

ALARM DEVICE FOR ELECTRIC MOTORS.—Walter A. Gibbs, Pawtucket, R. I. This is an alarm for motors in which an armature rotates within field magnets, and more particularly for the motors of electric cars, where the motor is so inclosed that the armature and shafting cannot be readily inspected to ascertain whether or not the armature is rotating evenly in its bearings. The invention provides very simple and inexpensive means whereby the armature is made to serve as an automatic circuit closer, indicating when the armature itself, from any cause whatever, whether from wear or displacement of bearings or springing or buckling of shaft, touches a field piece or stationary magnet of the motor. By this improvement every bearing may be used until it is worn out, and no inspection for wear or adjustment is necessary until the target indicates such need.

TRACK CIRCUIT RAIL JOINT.—George H. Williams, Fort Smith, Ark. This invention relates to a formerly patented invention of the same inventor, rendering the rail joint capable of conducting the current from one rail to the other. In the beveled upper edges of each of the fish plates is a longitudinal groove to receive a copper conducting wire, held by bending its ends downwardly on the ends of the fish plate, and made to bear firmly or jaw against the rail when the joint is screwed up, while a copper or steel spring in the form of a broken ring is fitted over two or all of the bolts between the inner face of the fish plate and the adjacent face of the rail web. The improvement is easily applied and the conductors are concealed, so that they cannot be tampered with or broken.

Mining, Etc.

SEPARATOR.—Albert Seneff, Laramie, Wyoming. This is an improvement more especially designed to facilitate placer mining, for separating the fine gold from the sand and tailings and also for treating pulverized material from quartz mills. Within a shaking frame is arranged a series of opposed, partly overlapping, inclined aprons, whose upper ends are nearly at the same level, while the aprons are pivotally connected to the frame at their centers to permit of adjusting their inclination. There are stationary and shaking aprons, and the aprons receive material directly from a feed sieve, the material being discharged from one set of aprons to the other, and the meshes of the fabric in the final aprons being designed to retain the last of the gold washed down.

Mechanical.

LATHE ATTACHMENT. — Walter H. Gripman, Sioux Falls, South Dakota. To facilitate cutting gears, grooving taps and reamers, splining shafts, cutting T slots in chucks, and various other work done on a milling machine, this inventor has devised an attachment consisting principally of a base plate adapted to be secured to the tool block, and carrying a casing mounted to turn, a shaft frame sliding in the casing having bearings for the milling tool shaft. On the casing and on the base plate are graduations, to aid in setting the casing, and the entire attachment is adjustable on the lathe in a transverse direction, and moves with the feed carriage in the usual manner.

FOURDRINIER MACHINE.—Thomas H. Savery, Wilmington, Del. This invention provides improvements whereby any particles of pulp or other matter carried by the return run of the deckle strap are removed and carried off beyond the machine. The strap passes in the usual manner around two flanged wheels, one near the breast roll and the other near the suction boxes of a Fourdrinier machine, and passes through a wash box in which are curved and segmental supports and lateral springs, the strap in its passage being not only washed and cleansed of all foreign material, but being guided, wiped and dried.

SCREW POINT SWAGING. — Simon Zolot, New York City. In a mechanism for making gimlet points on screws, this inventor provides improved cutters and means for moving the cutters from each other while producing the point. The cutters are carried on supporting slides moving transversely of the direction of the feed, and are operatively connected with a longitudinally moving slide which has diverging guides engaging the cutter supporting slides to move them in opposite directions.

MACHINE TO POINT BUTCHERS' SKEWERS.—Frederick Harrison, Owen Sound, Canada, This machine automatically feeds blank pins in double lengths to the cutters by a rolling motion, by means of belts which press the pins against a rounded surface, where they are rolled and at the same time acted on by rotary cutters. By the novel arrangement of the cutters around the convex surface of the rolling beds the pins are tapered by one set of knives and the points sharpened by another set on the same head, the belts then dropping the pins into carriers by which they are conveyed to boxes convenient for handling.

MACHINE FOR MAKING HOOPS, HANDLES AND CARRIAGE MATERIAL.—James Fowley, Cobden, Ill. This machine cuts articles direct from the logs or saplings, and is a combination construction by means of which the logs may be flitched or cut up longitudinally by a saw and planer after having first moved the first two planer heads and gang saws back out of operative position. The machine not only cuts and shapes the hoops, but planes them by planer teeth or bits carried by the gang and main saws. The kerfing saws may be spaced apart as desired and the shaping cutters made in patterns to suit the adjustment of the knives, thus working out hoops or pieces of any desired widths.

Agricultural.

PLANTER. — Henry S. Blood, Park Rapids, Minn. This invention provides a regulating device to be used upon any character of seed planter, and controllable by the driver to gradually increase the distance between rows, if distance has been lost, or gradually decrease the distance, if distance has been gained, during the operation of planting. Means are also provided for driving the marking shaft or stopping its revolution, as well as for adjusting the markers. The attachment is very simple and inexpensive, and the driver has full control of the machine without leaving his seat.

INCUBATOR.—Archibald Kerr, Carmichaels, Pa. This invention relates especially to the construction and combination of the heating and moisture tanks of incubators, providing simple and inexpensive devices to promote an efficient circulation of both the heat and moisture, and also providing a regulating device, automatically operated, to control the heat in the incubator chamber. The thermostat, which is located in the incubating chamber, is preferably made of two elliptical strips of brass and an intervening strip of iron, the ends of the strips being secured together and the lower elliptical strip attached to the bottom of the incubator.

Miscellaneous.

BICYCLE SADDLE.—George L. Pierce and Joseph E. Parks, Brooklyn, N. Y. This is a ventilating saddle designed to automatically accommodate itself to the necessary movements of the rider. The cantle consists of an arched plate or bar whose extremities are connected by a semielliptical spring, bowed downwardly, and so connected with the cantle ends that each may have end movement on the other. The pommel also consists of two tubular horns into which extend members of the main supporting spring of the saddle body, this spring being preferably made of spring wire. It is designed that the portions of the body brought into contact with the saddle will be subjected to a minimum of strain, and will be in a great measure rested during continued riding, preventing any prejudicial effects.

SEWING MACHINE.—Richard M. Melhuish, London, England. This invention is for improvements in machines sewing straight buttonholes before cutting them, and more particularly insuring such smoothness and certainty of action and absence of vibration at high speed as to enable the machine to stitch the hole after cutting as well as before cutting. The vibratory work plate of the machine has an opening into which extends a rectangular clamping jaw of a work clamp section of spring metal, the jaw being slit in a longitudinal and vertical plane, while a spring moves the clamp upward and a cam presses it down upon the work.

APPARATUS FOR EVAPORATING LIQUIDS.—Leon F. Haubtman, New Orleans, La. Two patents have been granted this inventor, in one comparatively inexpensive apparatus a heated current of air being passed over a flowing sheet or film of liquid, to evaporate the water and finally discharge the solution in concentrated form. Steam is passed through several pipes in chambers of the heater and a liquor tank, and while the liquor is flowing in one direction air is drawn through the apparatus by a suction fan, and, becoming heated by the pipes, passes over the surface of the flowing liquor, taking up or absorbing the moisture. The degree of heat imparted by the steam is designed to maintain the liquor substantially at the boiling point. In another apparatus the liquid is condensed as it passes in a thin film or sheet through long lengths of tubing, a series of pipes being arranged vertically in a drum and communicating at their upper ends with a receiver and at their lower ends with an absorbing chamber, air being forced through the heater and into the absorbing chamber, and a perforated plate distributing the air in the latter chamber. The apparatus is designed to condense the liquors treated to any desired degree.

MANUFACTURE OF THERMOMETER TUBING.—Francis S. Tomey, Birmingham, Eng. This invention covers a method of making enameled tubings which are to have the scale etched through the enamel, producing a flat film of perfectly uniform thickness. The back of a piece having a bore is flattened, and the flattened surface is dipped into very hot molten enamel in a special form of furnace, the superfluous enamel being scraped off as the piece is removed to leave a uniform film, the enamel coated piece being finally drawn into tubing.

GAS GENERATING MACHINE.—Ulysses A. Garred, Lexington, Ky. This is a machine for the manufacture of heating and illuminating gas by forcing air through gasoline or other light hydrocarbon liquid, varying the carbon in the gas at will to suit any purpose, and without condensation in the pipes, making it practicable to run them in any direction and give no attention to traps or other places where similar gases would fill with sediment. The machine is constructed of material to be found in any plumbing or tinning shop, and it works automatically, being started by merely lighting any jet on the system of burners, when the drawing of gas from the reservoir causes water to flow into a motor which works according to the demand for gas.

GRAIN BINDING MACHINE TENSION DEVICE.—Philip R. Martin. Buffalo, North Dakota. In the binding mechanism for self binding harvesters, this invention provides a simple and inexpensive tension device by which the same tension may be applied to fine or course, rough or smooth twine, and be quickly and conveniently regulated. The device is hung under the binder, and has a post carrying a grooved wheel, a pivotally mounted plate carried on the post bearing against the side of the grooved wheel, the support also carrying a shoe, adjacent to which is a pivotally mounted arm carrying a roller, and the roller being spring-pressed against the shoe. The cord passes through the tubular end of the shoe, beneath a friction roller, once around a friction wheel, and through an eye to the binder.

DRAUGHT DEVICE FOR AIRTIGHT HEATING STOVES.—Thomas B. Gilmour, Dayton, Washington. This device is so made that at one movement of a damper or sleeve the air may be supplied to the bottom of the stove and cut off from the top, and vice versa, the air being then applied over the fuel to retard combustion. The flue conducting the air is airtight and is divided in an airtight manner, and while the draught device is attached to the stove the ashes and other sediment may be readily cleaned out.

HOT AIR AND STEAM BATH APPARATUS.—Salli Maschke, Berlin, Germany. This is an apparatus which may be used either as a hot air or steam bath, or a combination of both, and comprises an oven made of a number of detachable sections having at their adjacent ends registering apertures, the apertures being brought into registry by turning the sections, while an apertured cover receives a water heater. A casing incloses the oven, the shell being in two sections, and the upper section being removed when a steam bath is desired. The temperature within the casing is readily regulated.

CURTAIN POLE EXTENSION BRACKET.—Henry Reubel, New York City. This is a supporting bracket whose central member has a number of elongated holes, each having an enlarged portion, a pole carrying arm being guided in the supporting bracket. A button turning on the arm has a head which passes through one of the holes when in alignment with it, the head turning laterally while its shank engages the enlarged portion of the hole. The device is simple, inexpensive and readily adjustable.

SHUTTER WORKER —James S. Patten, Baltimore, Md. This invention is for an improvement in devices for opening and closing shutters from the inside of the window, automatically locking them in open or closed or in intermediate position. The invention includes a geared shutter lever and worm, with a housing having a vertical pendent pin on which the lever is journaled, the housing having a lateral flange which, when bent into horizontal position, works in contact with the geared lever and supports it. The device is readily attached to or detached from the window casing.

FOLDING CHAIR. — Harrison Owens, Montesano, Washington. This is a chair particularly adapted for use in theaters, etc., and when folded up it may be revolved freely upon its support, facilitating the exit of the audience. The base has a vertical standard on which is vertically movable a frame capable of locking with the base, there being also a pivotally mounted back and seat, and a cam fixed to the seat engaging the standard. When the seat is dropped to a horizontal position the frame is automatically locked upon its support, it being possible to lock the chair in any desired position.

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Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(6979) L. W. asks for a recipe for a hair curling fluid. A. Take borax, 2 ounces; gum arabic, 1 drm.; add hot water (not boiling), 1 qt.; stir, and as soon as the ingredients are dissolved add 3 tablespoonfuls of strong spirits of camphor. On retiring wet the hair with the above liquid.

(6980) H. & C. ask: What is the best proportion of ingredients to make a concrete wall for an engine house 22×34×12 feet high, 12 to 16 inches thick? A. In a concrete building the best hydraulic cement should be used. The proportions should be 1½ cement, 2 of clean sand with 3 parts broken stone. See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 119, 285, How to Build Concrete Walls and Houses.

(6981) A. K. D. asks: Will you kindly explain which requires the most power—a water tower being 100 feet high, 8 feet diameter, with a feed pipe entering the bottom 6 inches diameter, or a 6 inch pipe 100 feet high, both considered to be full? A. It requires more power to pump through the pipe than to pump direct into the bottom of the water tower by the amount of the friction in the pipe.

(6982) Y. A. P., Jr., asks: Will a ground on one line of an alternating machine affect the machine? It is a 1,500 light Wood system. If so, why and how? A. The effect of the grounding will be practically nothing, but it introduces an element of great danger and should not be tolerated under any circumstances.

(6983) A. B. C. asks: 1. I have built motor 783 and it runs nicely. When running as a dynamo at 1,500 revolutions per minute in series with a galvanometer, it gives a deflection of 80°. If speed is further increased, the needle gradually falls toward 0, and even reaches 0 if the speed is very great. The galvanometer is wound to 1·64 ohms. What is the cause of the reduced current? Is this action common in all dynamos? A. Instances of drooping characteristic may be found in Thompson's "Dynamo Electric Machinery," pages 204, 205. They are to be anticipated when the field is weak compared to the armature. The lead of the brushes is also involved. The reducing the E. M. F. to 0 is a rather peculiar case. 2. Is the counter E. M. F. of a motor equal to its E. M. F. when run as dynamo at the same number of revolutions, if the strength of field magnets is constant? A. If the machine used as a motor rotated without resistance, then the two E. M. F.'s would balance each other. As there is always some resistance, the counter E. M. F. is less than the absorbed E. M. F. 3. If you send the secondary current from an induction coil through the primary coil of another instrument, why is there not a current in the secondary coil of the second instrument strong enough to be felt, if the first is strong enough to give a severe shock? A. The current in the secondary of an ordinary induction coil is very small; the shocking effect is due to the high potential and sudden changes of potential. 4. Knowing size and speed of a driving wheel, and size of a pulley, how can the speed of a pulley be calculated? A. Divide the diameter of driving pulley by that of driven pulley and multiply the speed of driving pul-

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ley by the quotient. 5. Is it necessary for the carbons of an arc lamp to come together to establish the arc? How is this done? A. Yes. They remain in contact until a current passes. The action of this then draws them apart. See our SUPPLEMENT, Nos. 694, 695, 696, 1047, 1048, 1049, 1050, 1051 and 1052, for full details on the action and mechanism of arc lamps. 6. Does the working current or the excess of current pass through the field winding of a compound dynamo? Is the compound coil wound in opposition to the main coil? How does this winding make the dynamo self-regulating? A. Almost any result may be brought about in compound winding. In the simplest case part of the entire current goes through the field coils in the same direction as the current of series connection. See our SUPPLEMENT, Nos. 600, 844, and 865, price 10 cents each.

(6984) C. N. H. says: 1. What is the formula for blue print paper? Does the addition of citric acid to the water in which the prints are washed have any beneficial effect upon them? Is there any modification of this process which will produce black or brown tones? A. Send 20 cents for papers giving formulas for blue print paper. We can see no advantage in using citric acid.

To Change Blue Prints to Brown.—

Borax	2½ oz.
Hot water	38 "

When cool add sulphuric acid in small quantities until blue litmus paper turns slightly red, then add a few drops of ammonia until the alkaline reaction appears and red litmus paper turns blue. Then add to the solution 154 grains of red crude gum catechu. Allow it to dissolve with occasional stirring. The solution will keep indefinitely. After the print has been washed out in the usual way, immerse it in the above bath a minute or so after the desired tone has been reached. An olive brown or a blackish brown is the result.

(6985) A. L. N. asks: 1. What is the best known filling for fireproof safes? A. Alum is one of the best known fireproofing substances. It gives off its water of crystallization, thereby absorbing heat. Slaked lime and sodium sulphate would be good substances. As non-conductors only, asbestos or any mineral boiler covering would be good. 2. What kind of primary batteries would be practical to use for four 8 candle lamps? A. Use bichromate batteries. They will entail expense and trouble. 3. In the science of to-day, is gold considered to be an element or a compound of some other elements? A. It is considered an element. 4. What is the cheapest way to produce X rays, and smallest coil one could use? A. Use a coil capable of giving a four inch spark. We have published a large number of excellent articles on this subject, to which we refer for details. 5. If I inscribe a polygon in the base of a cone, how can I find the angle subtended by radius of circle inscribed in polygon, the vertex of cone being vertex of angle? A. Let a=radius of inscribed circle of polygon, b = radius of base of cone and α = angle sought, B=angle of cone, then tan $\alpha = \frac{a}{b}$ tan B. The relation—may be found for each case by geometrical methods.

(6986) N. N. writes: 1. I have a series dynamo, 50 volt, one 32 candle power lamp; with the brushes on the commutator in a certain place, it lights the lamp. One more lamp in parallel, the lamps burn much brighter, and with three lamps it burns too bright, and with four lamps it will blow up one or two of the lamps. What is wrong with it, or do I have to shift the brushes for every lamp I add to it? A. Nothing is wrong with the dynamo. The lamps are of insufficient voltage. Try putting the lamps in series of two and then arrange the series in parallel. Or use lamps of higher resistance. You must not expect a plain series dynamo to be self-regulating. 2. What is the resistance of a 50 volt, 32 candle power lamp hot? A. About twenty-two ohms. 3. Is there a liquid or chemical, when placed in contact with nitroglycerine, that will explode it? A. Impurities will bring about slow decomposition and possible explosion. No practical way of exploding by contact with a liquid is known. 4. Please let me know of a powerful explosive, actuated by an electric spark. A. Gunpowder. The higher explosives are best exploded by a detonator, but gunpowder is very reliable for spark ignition. 5. Can resistance box be put in a series dynamo to advantage? A. A resistance box involves waste of energy, but it can be used with advantage in some respects.

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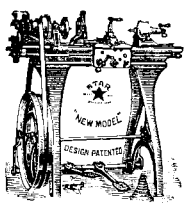

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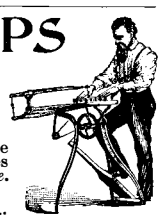

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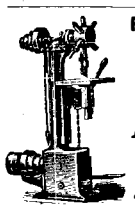

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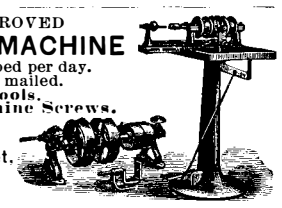

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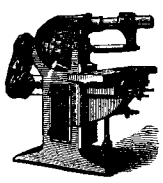

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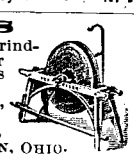

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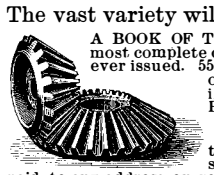

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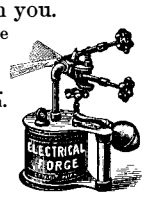

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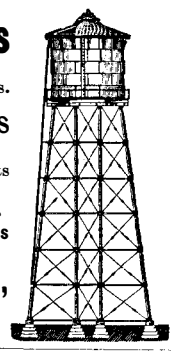

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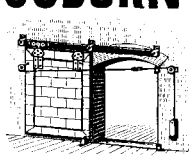

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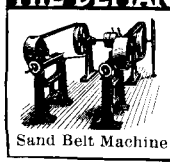

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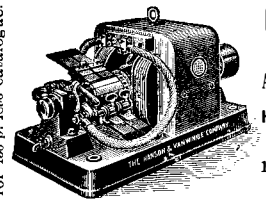

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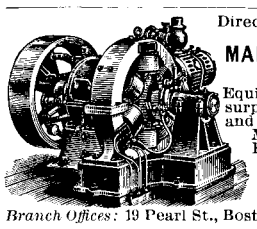

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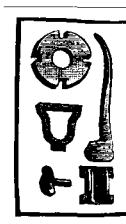

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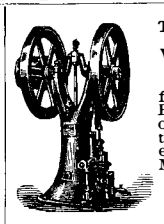

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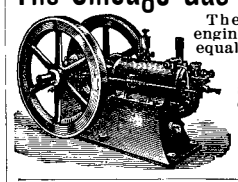

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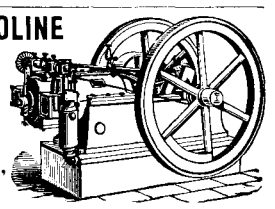

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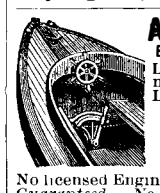

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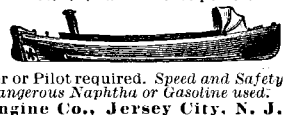

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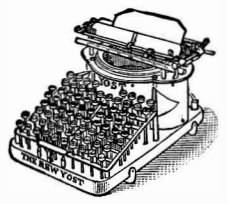

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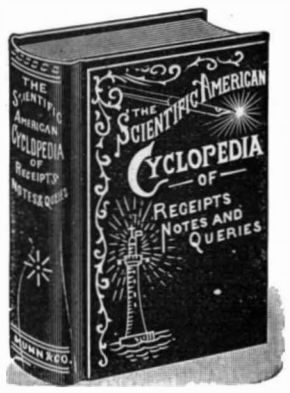

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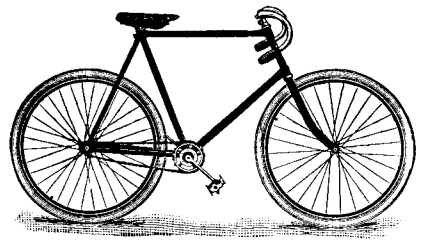

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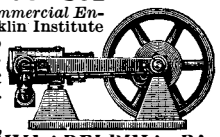

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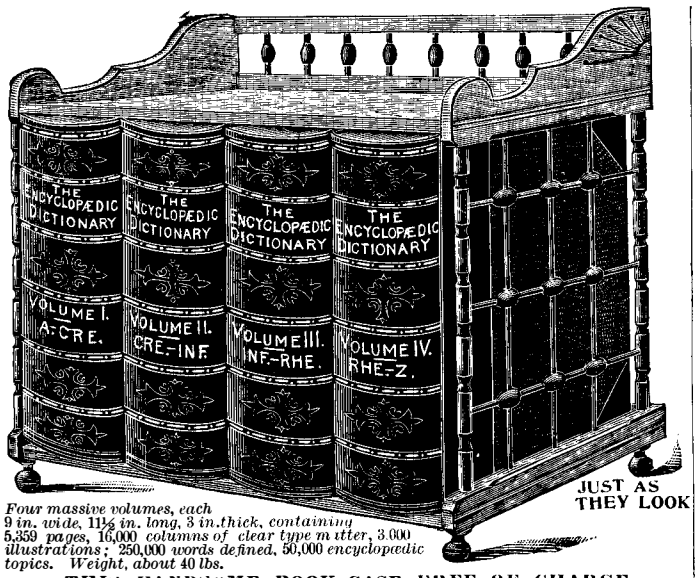

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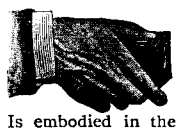

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